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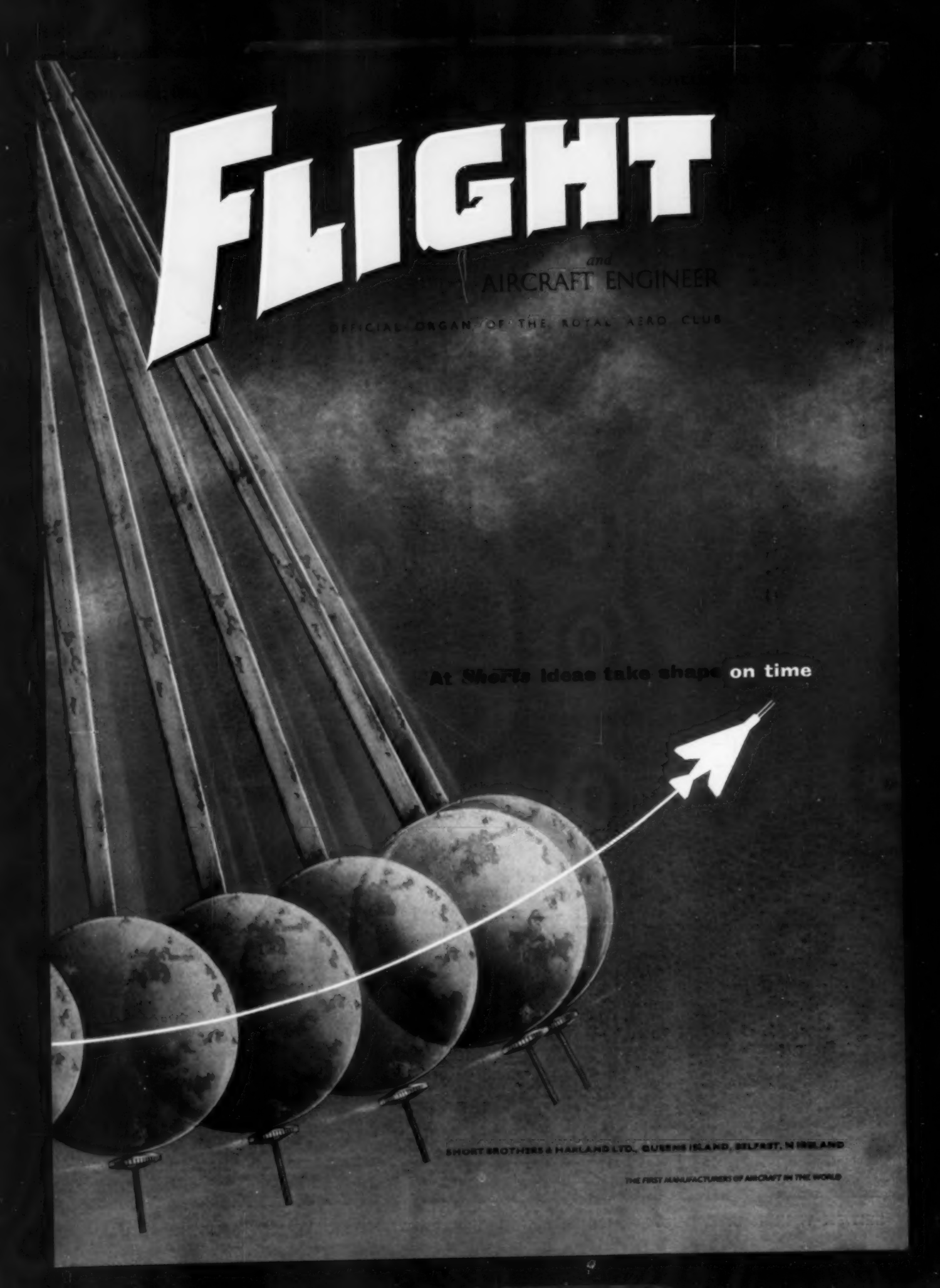
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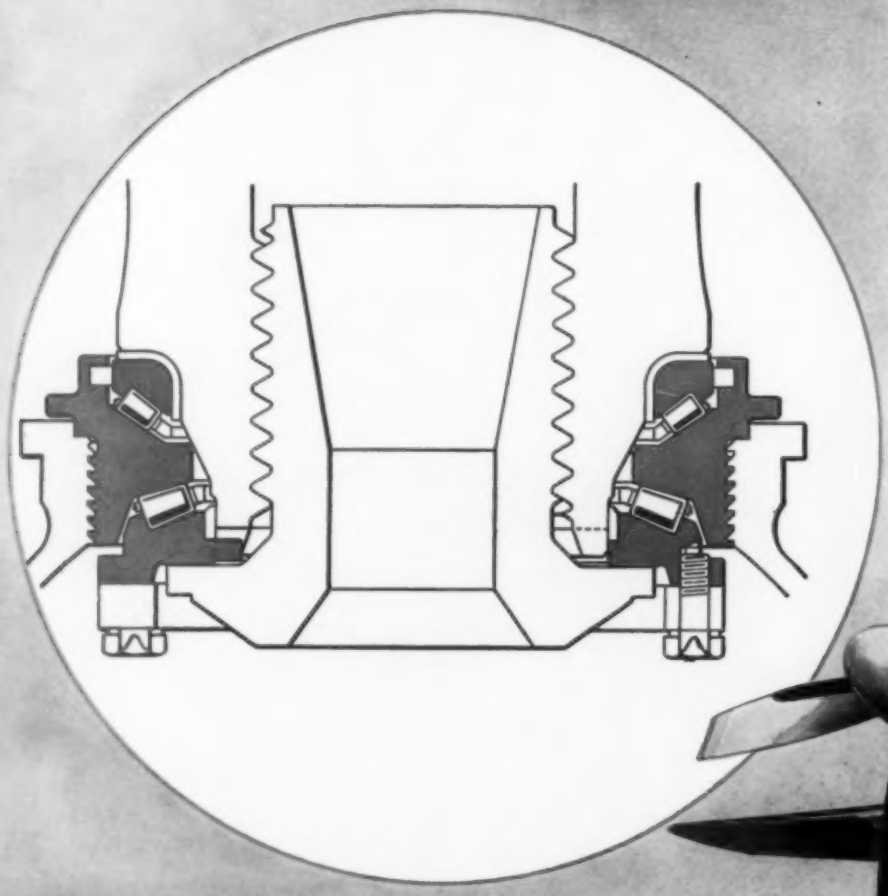

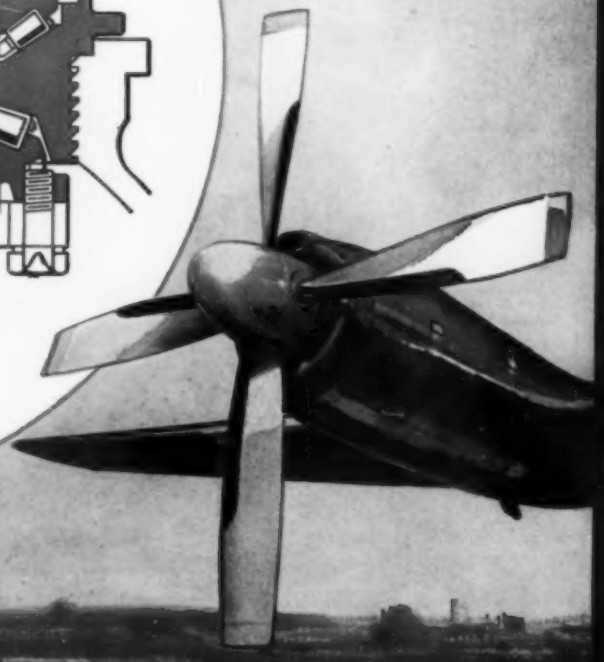

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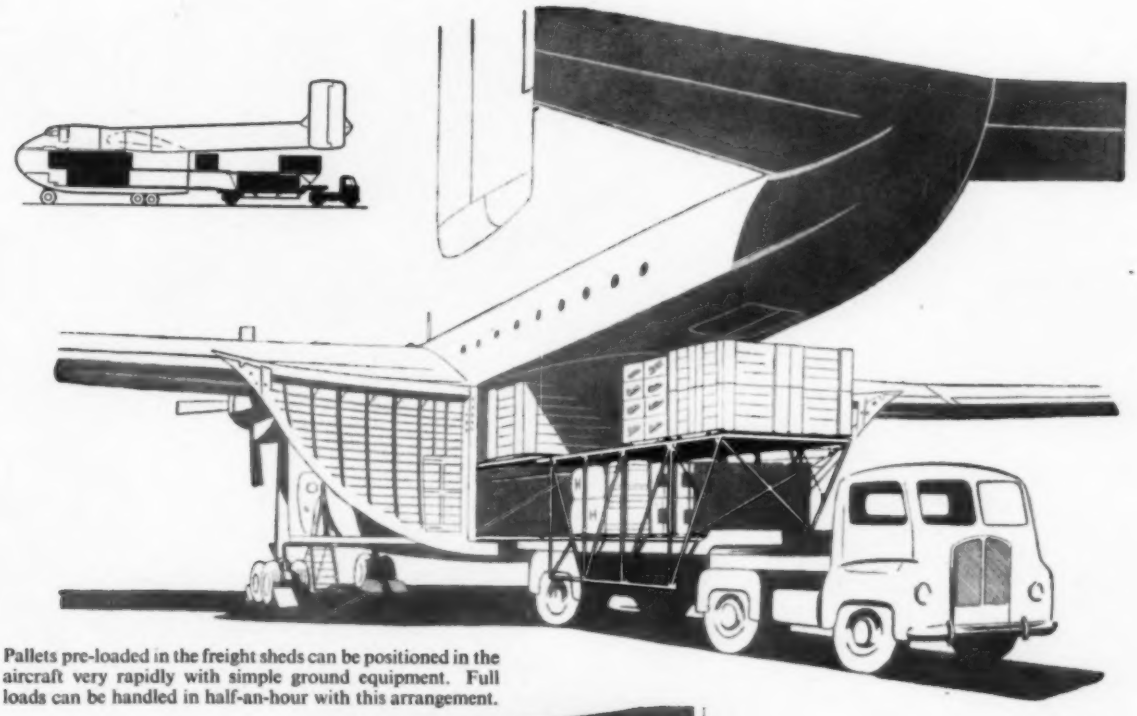

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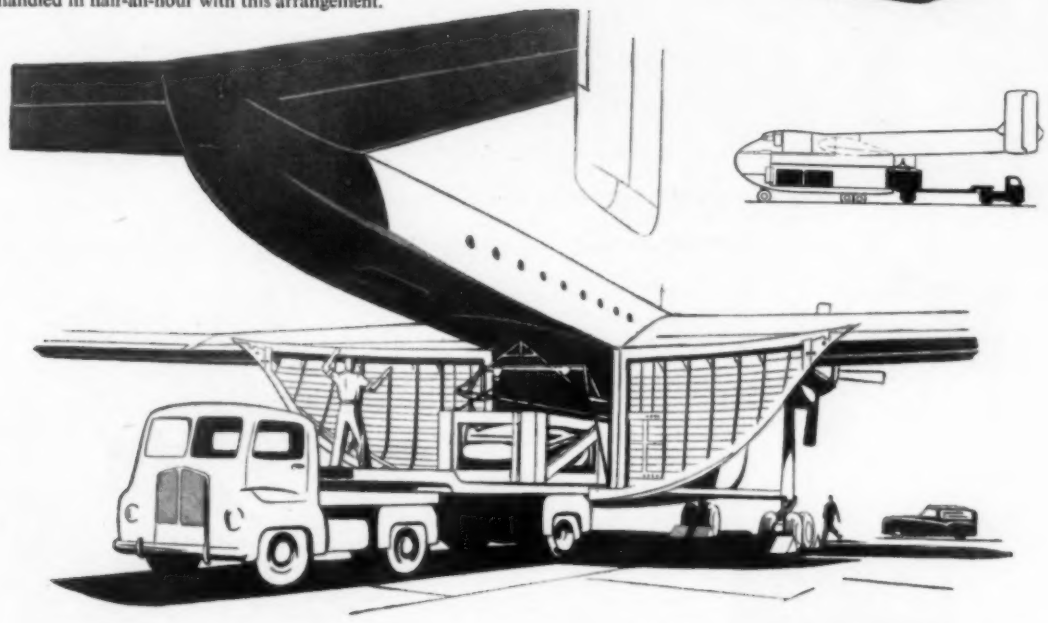

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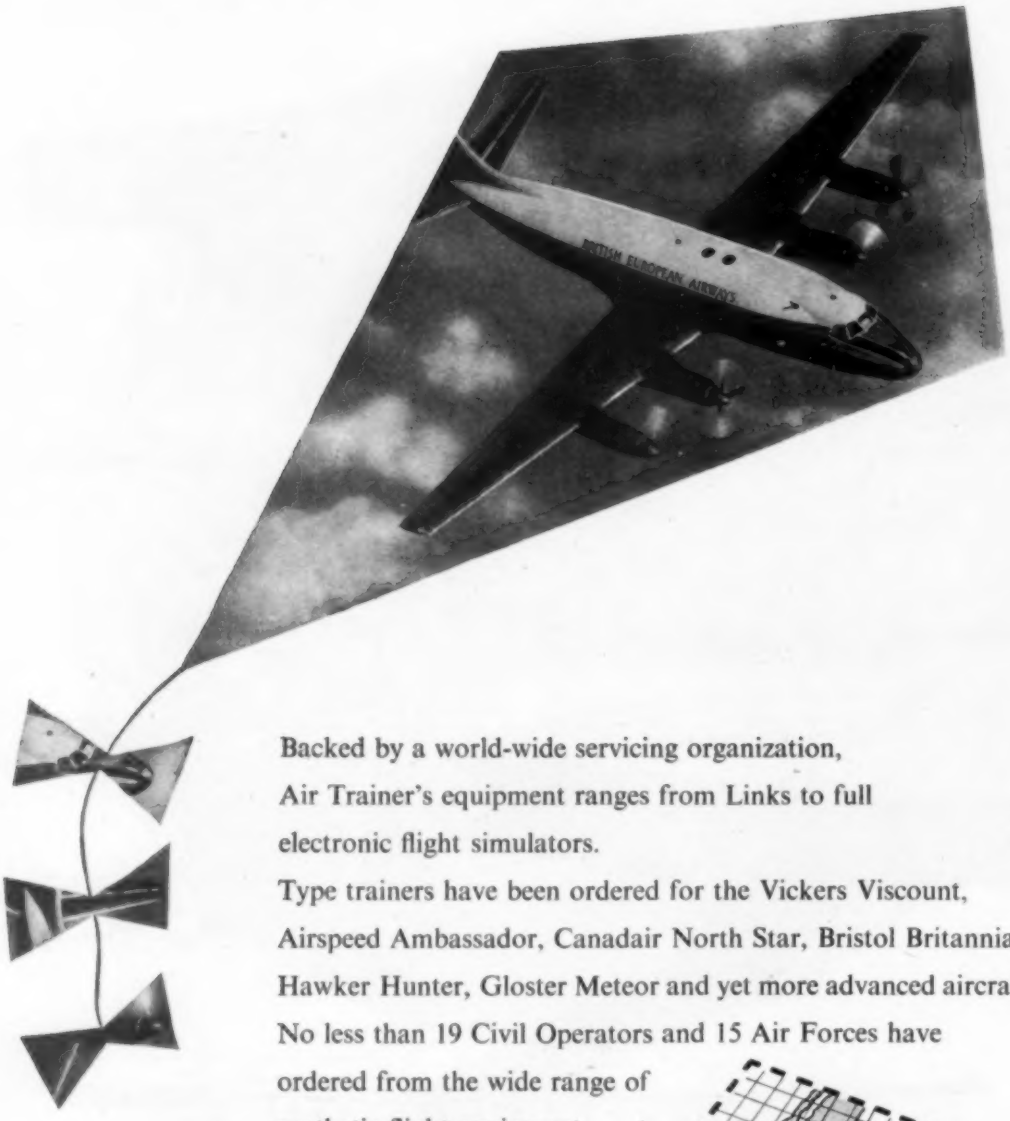

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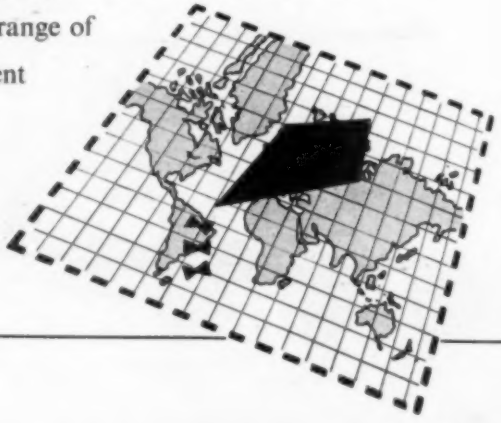

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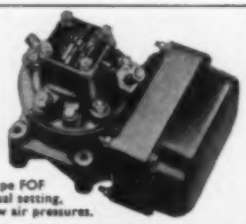
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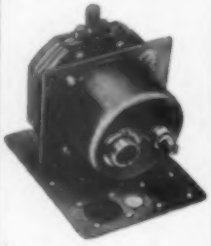
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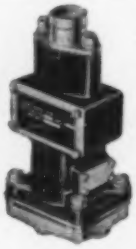
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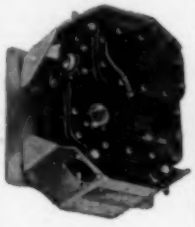
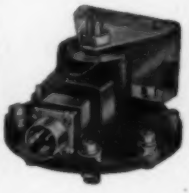

Type FLY Pressure ratio.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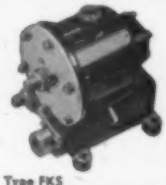
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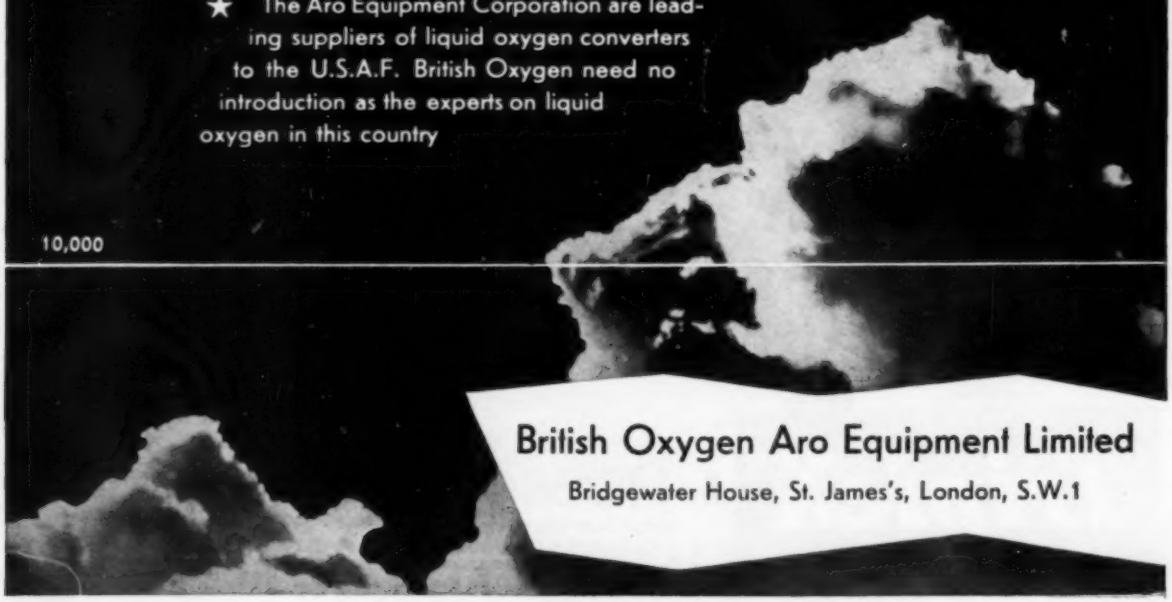

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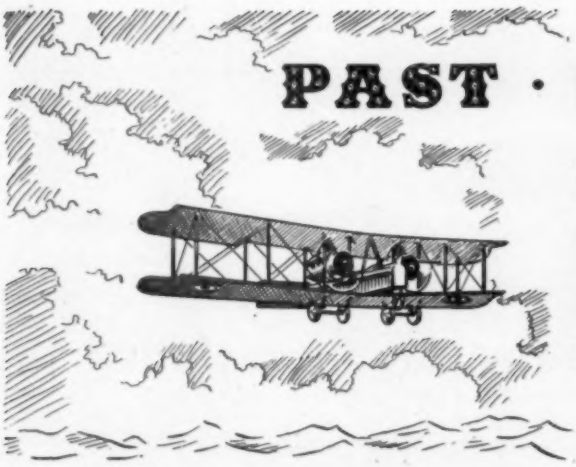

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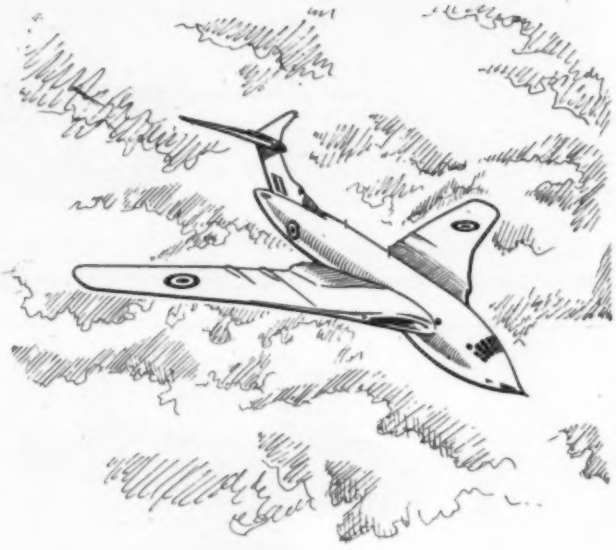

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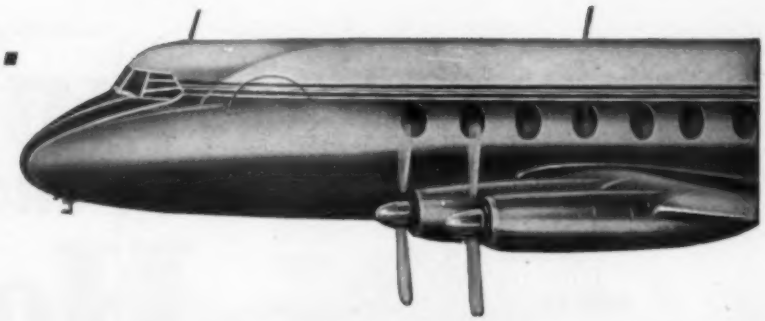

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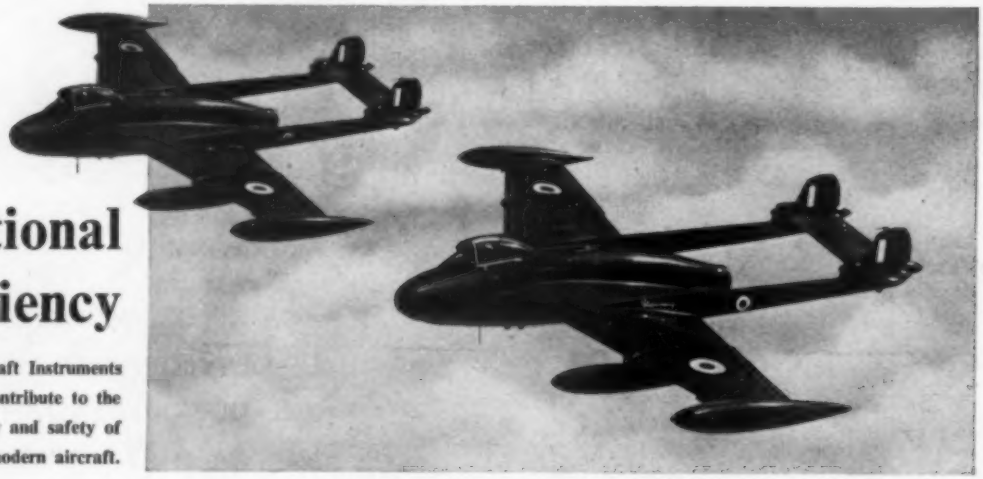

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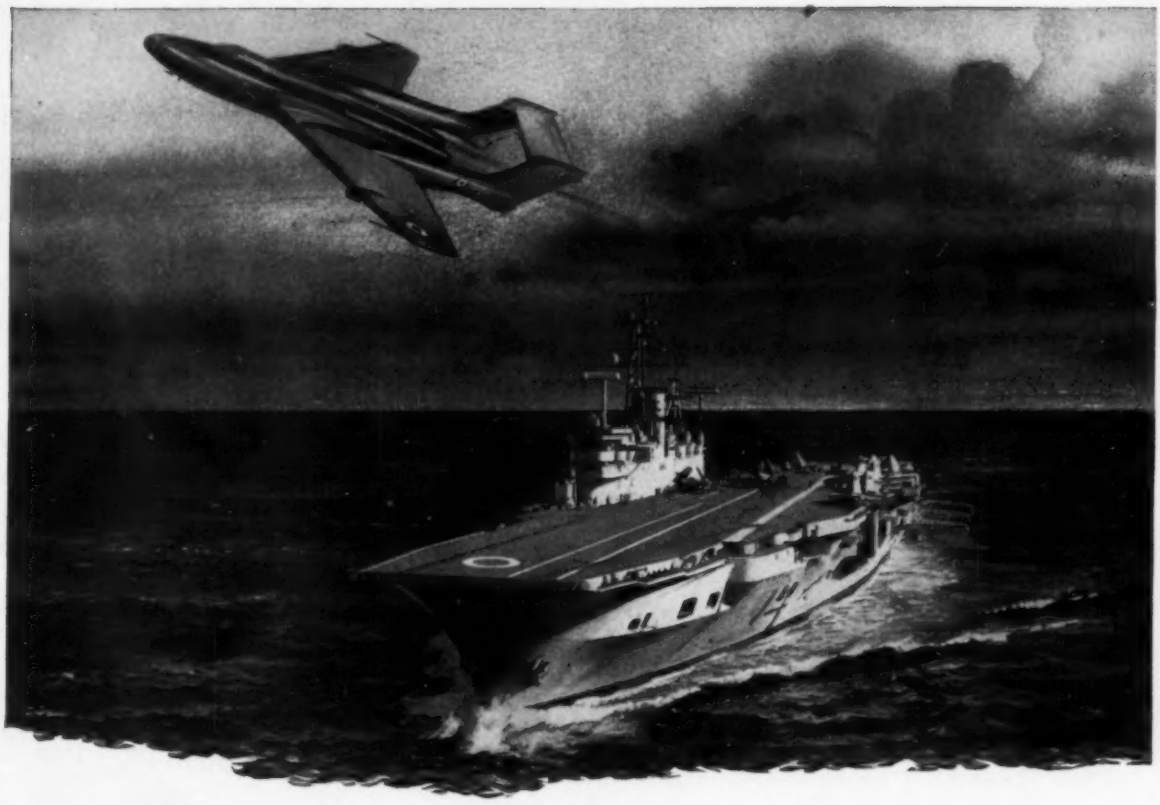

Fly as an Officer in
BRITAIN'S NEW NAVY

Far-reaching changes in the Officer Structure of the Royal Navy were announced in January, and the Fleet Air Arm Pilots and Observers now have even better pay and prospects. Pilots and Observers enter the Royal Navy on the new Supplementary List for an initial period of 12 years, with the option of leaving after 8 years. They receive a tax-free gratuity, or can apply for selection for a pensionable career after 10 years. Gratuities and pensions are greatly increased as a result of the new pay code that came into force in April.

In the development of the Fleet Air Arm the Navy has made outstanding advances. The new Battle Group tactics are centred on the aircraft carrier, making the Fleet Air Arm the main striking force of Britain's New Navy.

The Observer sees most of the game

Flying aircraft like the Sea Venom and the DH.110—all-weather night-and-day aircraft—depends more than anything else on teamwork between Pilot and Observer. It is the Observer who operates the radar, 'cons' the aircraft into position for attack, and navigates. He has got to be on the top line physically and mentally and there's a lot of highly technical knowledge to acquire before he qualifies. Now that the Fleet Air Arm is the spearhead of the Navy the aircrew have a personal responsibility for the success of the whole show.

"It's all a question of 'know-how'" says the Pilot "Flying jets off carriers would be a tricky business without the Navy's 'know-how' to overcome the difficulties, step by step. The answer to higher landing speeds is safer landing aids. So we have the 'mirror' sight to direct you into a well-judged touchdown, and the angled deck to give you a clear run off again if for any reason the first touchdown isn't perfect. And of course for take-off the new steam-catapult is more efficient and powerful than anything we've had before."

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FLIGHT
and
AIRCRAFT ENGINEER No 2496 Vol 70 FRIDAY 23 NOVEMBER 1956

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Supply and Demand in 1962

IT has been said that the world's airlines, in ordering so much new equipment during the past twelve months, must have taken leave of their senses. Superficial consideration of the facts might suggest that this is indeed the case; but a closer scrutiny—such as we make on pages 831-834 of this issue—gives a different interpretation.

We have set our sights at 1962 as the year in which the orderbooks of today will be translated into actual aeroplanes well bedded down in operational service. The largest estimate of their work capacity, plus that of the surviving piston-engined transports, discloses a substantial gap between the demand of traffic and the supply of capacity to carry it.

If more reasonable estimates are made of likely balance between traffic and capacity in 1962 this gap is considerable. We recorded in last week's issue a statement made by Boeing that throughout the sixties there will be a market for 1,500 medium jet transports and possibly 300 big jets—an appraisal which in our view gives realistic scale to the size of the future market. Unless there is a world catastrophe, the rise of traffic will continue inexorably as air travel becomes more widely accepted by surface travellers, as the fares they pay are reduced, as the world population and its living standards rise, and as new routes are opened and old ones intensified.

There is no doubt about the big business in store for the manufacturers, and no disputing the fact that—theoretically—there is enough of it to be shared profitably among the dozen or more of them. Precisely how it will be distributed in practice is of course the unanswerable question. Though it appears that not many more long-haul or medium-haul airliners will be ordered for delivery in 1959-1960, so dynamic is the growth of the airline industry that each ensuing year will see airlines as hungry as ever for more capacity. Probably those manufacturers with production lines well established in 1959 and 1960 will be the ones most favourably placed to supply the needed capacity ton-miles (or, to use the unambiguous units of I.C.A.O., tonne-kilometres).

There may have been surprise at the orders placed in 1956. There will, we predict, be greater surprise at the size of the orders that will surely follow.

Chemical Fuels

THERE is confident prediction in the United States (reports *Aviation Week*) that the production of chemical fuels for aircraft propulsion will soon become a billion-dollar business; and our contemporary goes on to suggest that not only turbojet/afterburner combinations, but ramjets and rocket motors also, will call for "a variety of propellants drawn from the vastly expanded fuels spectrum." Spectacular increments in performance are promised for aircraft and missiles, and current calculations are said to indicate that turbojet performance could be increased by at least 50 per cent. Reductions in fuel weight, tank volume and engine dimensions are attendant benefits in prospect.

Tangible progress in the production and application of these new exotic fuels is reflected in the recent re-evaluation of America's WS-110A "bomber delivery system," calling for a long-range aircraft with a supersonic "dash" performance in the target area. Boeing and North American proposals are under review, but it is not clear whether these would call for entirely new powerplants, operating solely on chemical fuel, or whether they would employ turbojets of existing pattern adapted to use one of the new fuels (probably pentaborane) in their afterburners. But whichever system is intended for these bombers, it is clear that American aircraft and missiles may be receiving a very potent "shot in the arm."

In this country, on the other hand, no reference, official or otherwise, has been made to development of chemical fuels; and any British undertaking is unlikely at present to be broadly based. It is pertinent to note, however, that Rolls-Royce and North American Aviation (which company we have already mentioned in association with chemical fuels) have a ten-year technical-assistance programme; and though this has been stated to apply to "rocket systems," its terms might conceivably be broadened to embrace these richly promising new fuels.

FROM ALL QUARTERS

Civil Airlift for the Hungarians

SEVERAL practical moves to help Hungarian refugees by the use of aircraft were made last week. A Viking of Eagle Aviation, Ltd., took off from Blackbushe for Vienna last Friday morning loaded with supplies, and a DC-3 chartered by the Institute of Directors left Lympne for the same destination that afternoon with four tons of food and medical requirements. Both were due to bring back refugees to this counry. The Royal Aero Club informed the International Help for Children organization that 30 of its members had offered to fly their own aircraft—ranging from Doves and Rapides to Proctors and Austers—at their own expense to Austria to bring back refugee children.

Last Sunday the British Red Cross headquarters in London said there would be a regular airlift of three aircraft a day from Linz, Austria, to Blackbushe carrying Hungarian refugees. These flights would each bring about 30 people, accompanied by a Red Cross official. The service is due to continue for two or three weeks, until the 2,500 homeless Hungarians accepted by Britain—some of whom are travelling overland—have arrived. Further notes on air transport of the refugees appear on p. 835 of this issue.

Egyptian Balance Sheet

SPEAKING at Mold, Flintshire, last Friday on the Egyptian operations, Mr. Nigel Birch, the Secretary of State for Air, said that there had never been better co-operation between the Services. "Nowadays people often speak of the desirability of all three Services being merged into one," he went on. "I do not myself believe that this would be of benefit. I believe we should act in accordance with the Arab proverb, 'keep your hearts together and your tents separate'." The Air Minister added that the operations had shown how merciful the exercise of air power could be "provided your force is well trained and its technical equipment good enough. In the event, the great fleets of Russian aircraft were neutralized at the cost of only very few lives."

HUSTLER: Glimpsed during its first flight, on November 11, is the first Convair B-58 Hustler supersonic bomber. The flight lasted 38 min. Under-fuselage weapon pods will take air-to-surface missiles, counter-measures equipment, or a bombing system, and auxiliary rocket motors will confer a high-supersonic "dash" performance.

UPLANDS TO MARVILLE: The ceremony which recently marked the send-off of No. 445 Squadron, R.C.A.F., from its base at Uplands, near Ottawa, to take up NATO duty at Marville, France. The CF-100s of the squadron—one of four all-weather fighter units for Europe—are seen to be camouflaged in the standard R.C.A.F. grey and green.

Figures for casualties in the Egyptian operations were given last week in the Allied Forces Communiqué No. 38, issued from Cyprus. For the R.A.F., these showed three officers and one airman killed; no wounded; no missing. Two R.A.F. aircraft were lost, one through enemy action and the other as the result of an accident. Royal Naval casualties were:— one officer killed; no wounded; no missing. Six R.N. aircraft were lost, four of them through enemy action and two as the result of accidents.

When the aircraft carrier *Theseus* was on her way to Malta last Friday, with Allied wounded aboard, a Shackleton of R.A.F. Coastal Command dropped emergency medical supplies. This operation was carried out in a storm and the captain of the aircraft, F/L. R. Buckwell, said afterwards: "Dropping instructions were passed to us by radio as we could not see the ship, due to a huge rain cloud in the area." The Shackleton made two runs alongside *Theseus* at 150ft and released the supply containers over sea markers which had been laid by the carrier. Two helicopters which were already airborne picked the canisters up and took them on board within about a minute.

U.N. Air Force

REPLYING to questions in the House of Commons about the provision of an air component for the United Nations force in Egypt, Mr. A. D. Dodds-Parker, Foreign Under-Secretary, said last week that the United Kingdom could see nothing in principle against the addition of such a component, and perhaps even a Naval one.

Doman in France

A DOMAN LZ-5 helicopter, a product of Doman Helicopters, Inc., of Danbury, Conn., is now in Europe for demonstrations and has completed an official flight-test evaluation by the French Air Ministry at Brétigny. The French Government are interested in its potentialities as a weapon carrier. A maker's announcement states that the LZ-5 was tested "both in a standard, enclosed passenger-carrying version and as a skinless military tactical helicopter". The demonstrations are being sponsored by Marcel Dassault, and the machine was taken to France at the invitation of the French Ministry of Defence.

THUNDERBIRDS: So named is this U.S.A.F. demonstration team, mounted on North American F-100 Super Sabres. It is to be hoped that the photographer who secured this spectacular take-off picture was wearing ear-defenders.

EL GAMIL airfield, Port Said, in use by Whirlwinds of a joint R.A.F./Army helicopter unit. Aircraft of this type figured prominently in the assault.

New London Airport Commandant

AS reported in last week's *Flight* (page 793) Sir John D'Albiac, K.B.E., C.B., D.S.O., commandant of London Airport, is due to retire at the beginning of next year. As we go to press an official announcement is expected—according to *The Times*—naming his successor as Mr. G. J. H. Jeffs, who has been commandant of Prestwick Airport since 1950.

"Jimmy" Jeffs, who is 56 years of age, has been closely connected with British civil aviation since his demobilization from the R.N.A.S. after the First World War. He was in charge of air traffic control at Croydon from 1922 until 1934, and at Heston from 1934 until 1937. Both during and after the Second World War—in which he attained the rank of group captain—he was mainly concerned with Atlantic air traffic control.

We hope to publish further notes about Sir John D'Albiac and his successor next week.

Derby Successes

FIRM orders are now held by Rolls-Royce, Ltd., for 2,500 gas-turbine aero-engines for civil use. This figure, representing more than half the world market, is made up chiefly by orders for 2,000 Darts. The next largest orders are for Conways and Avons (over 100 units of each); and contracts have been placed for more than 80 Tynes.

A spokesman for the company said that the contracts at present in hand meant that the Rolls-Royce Derby and Scottish factories would be working to full capacity, and extensive use would be made of sub-contractors.

EXTREME SOUTH: Bearing the title of a current song hit was this U.S. Navy R4D of Air Development Squadron 6, seen at the South Pole on October 31. The seven members of its crew were the first men to tread the polar snows since Capt. Scott's expedition of 1912.

Lt-Cdr. F. W. Merriam, A.F.C., F.R.Ae.S.

WITH the passing of Frederick Warren Merriam—who died at Christchurch, Hants, on November 12 at the age of 76—an interesting and distinguished link with the earliest days of British aviation has been severed. He was the first pilot in this country to fly through cloud (in a Bristol Box-kite, early in 1912); later, as manager and chief instructor of the Bristol Flying School at Brooklands, he had many pupils who subsequently became famous, including Air Chief Marshal Sir Philip Joubert de la Ferte, A. Cdre. P. F. M. Fellowes (who led the aerial Houston Everest Expedition), and Sub-Lt. R. A. J. Warneford, V.C., the first pilot to shoot a Zeppelin down; and it was only the toss of a coin at the Royal Aero Club which decided that Alcock, rather than Merriam, should accompany Whitten-Brown on the first direct transatlantic flight.

Lt-Cdr. Merriam.

At the outbreak of the 1914-18 war Merriam was the senior flying instructor in Britain, with an outstanding reputation for skill and patience, and he became chief instructor to the R.N.A.S. at Hendon and later at Chingford. Subsequently he flew on anti-submarine operations from Cattewater and Padstow, and after the war did some pleasure-flying and tested the Saunders Kittiwake flying-boat. In 1922 he founded Britain's first gliding school, near Shanklin, Isle of Wight.

During the last war Lt-Cdr. Merriam served with the Fleet Air Arm, his considerable experience of practical psychology proving useful on selection boards. Two years ago he published a fascinating autobiography, *First Through The Clouds* (Batsford), and just before his death he had completed another book on early flying called *Echoes from Dawn Skies*.

More SeaStars

LAST week the Lockheed Aircraft Corporation announced a further £25m order for the T2V-1 SeaStar, the new standard jet trainer of the U.S. Navy. Developed from the T-33 (also widely used by the Navy as the TV-1) the T2V is the first production machine to have boundary-layer control. The new order will extend production into 1958, and the first machines will join the Fleet in January next year.

"Flight" photograph

OUT OF THE PAST: Pleased with the Royal Aero Club's latest acquisition—a poster advertising the first aviation meeting in England (Doncaster, October 1909)—are Col. R. L. Preston (left), the Club's Secretary-General, and his assistant, G/C. J. F. H. du Boulay. The poster was presented to the Club by "Flight" reader Mr. Robert Henderson, ex-R.F.C., and is being compared here with "a pictorial souvenir" of the same meeting already in the Club's possession.

Consecutive ejection of two dummies from a sled-mounted Convair TF-102A cockpit at 240 m.p.h. At left, the M3 telescopic gun has thrown its seat to the arrowed position well below the rocket-assisted RESCU gun's smoke-trail. Above right, the dummies separate from their seats after one second, allowing (lower right) the automatic parachutes to open. The M3 seat is close to the canopy, while the RESCU seat curves right up and away from its dummy.

"RESCU"

ON this side of the Atlantic, Martin-Baker have successively developed and demonstrated their automatic ejector seats in ground-level, low-speed ejection; at speeds up to 420 kt I.A.S. at 1,500ft; and at heights of 40,000ft. Such seats are standard in all new high-performance Service aircraft.

In America the U.S.A.F. is now engaged in developing ejector devices for the more advanced performance of aircraft now in service or shortly to reach squadrons. The emergency ejection last year by North American test pilot George Smith from an F-100 (at just over Mach 1 at some 6,000ft), showed that, though the seat mechanism worked in those extreme conditions, far more protection was required to shield the pilot from the tremendous forces of airblast and deceleration. Capsules of various kinds have been suggested—one is being developed by Goodyear in America—but the only aircraft known to be so equipped is the Bell X-2 rocket-powered research machine. The first pilot to use this system was the late Capt. Milburn Apt, when the X-2 went out of control after a high-speed run recently. The recording camera mounted behind his shoulder was recovered afterwards and the film showed that he was violently thrown about the cockpit as the aircraft tumbled from 70,000ft to 45,000ft.

Apt pulled the capsule ejection handle; and then for two or three seconds more the capsule itself must have tumbled until the decelerating parachute opened. Subsequent speed of descent was calculated as about 128 m.p.h. and the time four minutes. In order to survive, Apt would have had to free himself from the capsule by jettisoning the canopy, undoing his seat harness and stepping out to make a normal parachute descent. He accomplished only the first two actions before striking the ground, with fatal results.

The standard U.S.A.F. seat-ejection gun at present used in high-speed aircraft is a three-tube telescopic, cartridge-operated unit designated M3. Though in itself efficient, it is (perhaps pessimistically) reported to be unsuitable for very high-speed ejection; nor is it believed to be more than marginal for the low-speed, ground-level case. Friction in the telescopic tubes under high drag loads, for example, considerably reduces ejection velocity at high aircraft speeds.

Flight of November 9 noted, on page 752, work being carried out by the Talco Engineering Company on a rocket-assisted ejection gun. Further details have now been released, and the accompanying pictures show a test ejection of two dummies from a Convair TF-102A cockpit section mounted on a rocket-propelled sled at Edwards A.F.B. One seat had the M3 gun and the other the Talco gun, which is called RESCU—Rocket Ejection Seat Catapult, Upward. This latter unit uses the standard 4-oz explosive charge to eject from the gun barrel the piston on which the seat is mounted. Near the top of its travel, the end of the piston is broken open by striking a positive stop, and, as the seat leaves the rails, the hot gases ignite a 5-lb rocket charge housed in the piston.

Directed at an angle through the c.g. of the loaded seat, the thrust of the rocket gives an upward force of 5,000 lb and a forward force of 4,500 lb, the resultant being 6,700 lb. Upward and forward g loads are respectively 15 g and 13.6 g. The forward component of the thrust counteracts the violent deceleration forces which mainly prove fatal in high-speed ejections. Longer propulsion time achieved with the rocket gives greater gain of height, without excessive g, after low-speed ejection. The critical factor is the timing of the rocket-charge initiation.

Even above 30,000ft, airloads on the pilot during supersonic bale-out may reach seven tons, with deceleration forces of up to 40 g. The safe forward limit is considered to be 35 g, and the upward (positive g) limit 20 g.

Two tests were carried out with the TF-102A cockpit on the sled. First the two seats were shot out at 240 m.p.h. at a Mach number of 0.3. After one second both dummies were released from their seats and the parachutes began to deploy. The whole sequence lasted five seconds. RESCU had lifted its seat to 124ft while the M3 had only reached 55ft. In the second test, made at 590 m.p.h., Mach = 0.73, RESCU achieved 60ft above the level of the TF-102A's fin-top. The M3 seat was fired shortly after the other in order to assess the effects of the rocket blast on the remaining dummy. Instrumentation showed that the temperature-rise was not at all dangerous. Both dummies carried instruments and telemetering radios.

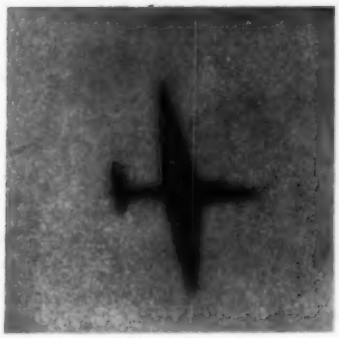
It is claimed that the rocket thrust tends to stabilize the seat after ejection as well as reducing deceleration forces to a level well within endurance limits. The danger of the extra 5-lb charge being ignited by enemy action is considered to be small, but there is the problem of the effects of rough handling and ageing on the stability of the explosive.

Convair at San Diego has been given a U.S.A.F. contract to co-ordinate all work on ejector seats for Air Research and Development Command. Some 13 companies are involved. It is hoped to develop a seat suitable for all "century series" fighters and other aircraft such as the SeaMaster and RB-66.

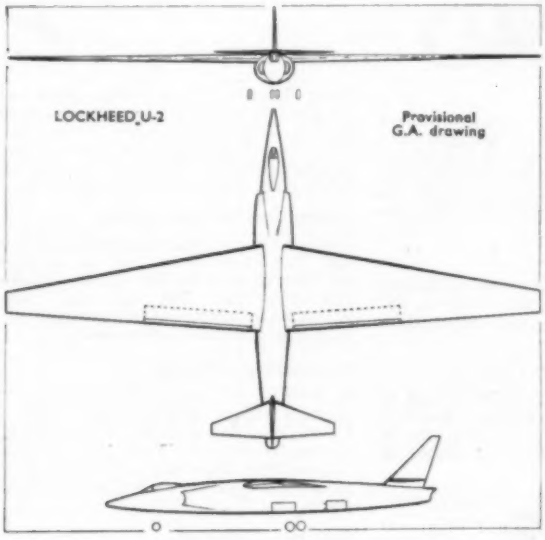
A rocket-assisted ejection seat gun similar to RESCU was developed and patented in 1954 by Mr. David Fulton, who was then working for Reaction Motors, Inc. He is now forming a company for its production.

LOCKHEED U-2

The "Mystery Machine" Depicted and its Elaborate Meteorological Research Equipment Described



BETWEEN 1300 and 1500 hours on August 15 last, at Wiesbaden, near Frankfurt, Germany, a reader of *Flight* took the much-enlarged photograph which appears in the heading. This may confidently be supposed to depict the Lockheed U-2, of which no picture has hitherto been published, at the behest of the United States Government and of the Lockheed Aircraft Corporation. The three-view drawing is based on the evidence of the reader who took the photograph and on that of a friend who accompanied him. A jointly compiled description reads: "F-86 Sabre-type dive brakes were seen extended on the rear fuselage on landing, as was a flap on the inboard section of the wing. The plane had a natural metallic finish with no national markings." The writers "definitely disagreed" with a previously published statement that the U-2 leaves its undercarriage behind,



for they saw the machine, with wheels down, making a "normal length" landing on a concrete runway.

During recent months several readers have reported sighting U-2s (there is a reference on the correspondence page this week), and since our leading article on July 6 we have received from Mr. Walter T. Bonney, Assistant to the Executive Secretary of the National Advisory Committee for Aeronautics, the following letter: "I am enclosing two releases about the high altitude research program which the NACA has undertaken and which employs the Lockheed U-2 airplane. Perhaps the information they contain will assist in dispelling some of the mystery which appears to have enveloped the project. At the time of the initial release (May 7), although not included therein, the relatively low speed of the airplane (a Mach number of about 0.75) and its high aspect ratio, straight wing were mentioned in discussions with the press."

The first of the two releases mentioned by Mr. Bonney confirms that the U-2 is powered by a single Pratt and Whitney J57 turbojet, and the second—dated July 9, 1956—describes the instrumentation installed. This release reads as follows:—

Initial data about gust-meteorological conditions to be found at 10-mile-high altitudes which have been obtained to date by the relatively few flights of Lockheed U-2 airplanes have already proved the value of the aircraft for this purpose, Dr. Hugh L. Dryden, Director of the National Advisory Committee for Aeronautics, said today.

"The airplane has shown its capability to climb to 50,000 feet and maintain that altitude for the time necessary to obtain the research information desired," Dr. Dryden said. "Further, it has adequate load capacity to accommodate the data-gathering instrumentation required."

Research flights covering the western part of the United States are being made from Watertown Strip, Nevada. Within recent weeks, preliminary data-gathering flights have been made from an Air Force base at Lakenheath, England, where the Air Weather Service of the USAF is providing logistical and technical support. As the program continues, flights will be made in other parts of the world.

Among specific research goals are more precise information about clear air turbulence, convective clouds, wind shear, and the jet stream. In addition, information about cosmic rays, and the concentration of certain elements in the atmosphere, including ozone and water vapor, is being gathered at the request of the USAF. It is expected that considerable time will elapse before sufficient information, covering all subjects of interest, has been obtained and reduced to useful form.

The instrumentation carried by the U-2 airplane includes special equipment furnished by the Wright Air Development Center and the National Advisory Committee for Aeronautics.

Turbulence data is being recorded on the following specially developed instruments furnished by Wright Air Development Center and the National Advisory Committee for Aeronautics:—

1. A VGH recorder developed by the NACA contains two pressure sensitive elements for continuously measuring indicated airspeed and pressure altitude, a galvanometer element for measuring the output of a remote acceleration transmitter, and a timing mechanism. Each element causes rotation of a mirror which in turn moves a reflected lamp image across the recording medium. Recording is effected on a 200 foot roll of 70 mm photographic paper.
2. A sensitive airspeed recorder similar to the VGH recorder except that a high sensitivity factor for airspeed is obtained by use of multiple mirrors on the airspeed pressure element.
3. A NACA VG recorder that scribes an envelope of acceleration against airspeed on a smoked glass plate. This record is immediately ready for inspection following flight.
4. A NACA turn meter that records optically on a 50-foot roll of 2-7/16 inch photographic film. This meter is oriented so as to record the airplane's rate of pitch.
5. A new turbulence recorder developed by Wright Air Development Center, "Flight Recorder Model BB" continuously records indicated airspeed, pressure altitude and normal acceleration on arc-sensitized paper. The record of this instrument is immediately available for inspection following a flight.

Improved equipment, to be added as soon as development work currently is completed, will include an infra-red hygrometer for accurate measurement of dew point, an improved vortex temperature probe, a vortex psychrometer for measuring true free air temperature and relative humidity, a means of measuring visibility and improved turbulence measuring and recording equipment.

True free-air temperature is being measured by a vortex thermometer system ML-470/AMQ-8 that was developed by the Naval Research Laboratory to measure true free-air temperature with an accuracy of one half degree Celsius. Air flows through a corkscrew type spinner vane that creates a vortex, cooling the air at the center of the vortex by an amount equal to the dynamic heating for that flight speed. The temperature at the center of the vortex will then be equal to ambient temperature. A precision wire-wound resistance temperature element is located in the center of the vortex. This temperature measuring system has been tested on a whirling arm and found to have an accuracy of better than one-half degree Celsius at speeds up to 500 knots.

Indicated free air temperature and indicated relative humidity are being measured by temperature-humidity measuring set AN/AMQ-7. The system was developed for the Air Weather Service by the Evans Signal Laboratory at Belmar, New Jersey. It has a recovery factor of about 0.87 and has a precision thermistor for measuring temperature and a carbon strip for measuring humidity. The carbon strip is a new element that consists of a humidity sensitive carbon coating which changes in resistance as the humidity changes.

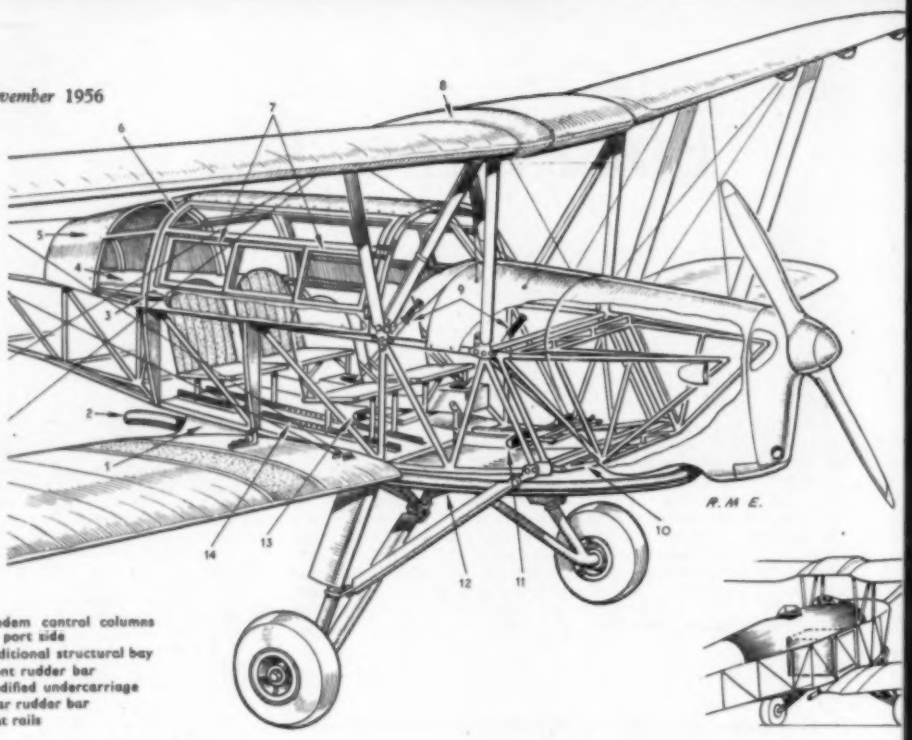
Pressure altitude is measured by a precision pressure transducer that furnishes an electrical signal to an aerograph recorder. Air speed is measured by an airspeed transducer.

The AN/AMQ-7 temperature-humidity measuring system and the AN/AMQ-8 vortex thermometer have been modified to connect their electrical output into the KS-4 Aerograph system for automatic recording.

The KS-4 Aerograph system is designed to receive data inputs of atmospheric measurements and to indicate these values both visually and graphically. It is capable of recording six functions, five graphic and one numerical. Each graphic recording channel consists of a complete servo mechanism which positions a stylus on a lead screw in proportion to the electrical angle of a transmitting synchro. The servo mechanism consists of a two-phase motor, a synchro lead-screw and stylus and suitable gearing . . .

The magnetic heading measured by the gyrosyn compass is fed into and automatically printed in numerical form by the KS-4 Aerograph. Winds are computed from headings and airspeeds recorded on the KS-4 Aerograph and drift and ground speed data recorded by the pilot from the driftmeter.

HERE AND THERE



THRUXTON JACKAROO: A "Flight" copyright sketch showing the salient features of this ingenious Tiger Moth conversion, described on page 826. The inset sketch depicts the crop-duster version, with a single cockpit on the port side and instrument panel on top of the fuselage decking.

1 Wing fillet
2 Long exhaust pipe
3 Cabin door handle
4 Parcels shelf
5 Plywood skin
6 Cabin door
7 Sliding windows
8 Fuel-tank fairing
9 Tandem control columns on port side
10 Additional structural bay
11 Front rudder bar
12 Modified undercarriage
13 Rear rudder bar
14 Seat rails

Said and Done

ON November 18, six helicopters carrying a platoon of Argyll and Sutherland Highlanders landed on a small island in Lake Manzala, west of Port Said. The raiding force searched and questioned a group of Egyptians manning a coastal battery, and took three prisoners and some arms and ammunition.

Ordered for Germany

IT is now confirmed that Western Germany has placed orders for 68 Hawker Sea Hawks and 16 Fairey Gannets for the Air Force and Navy. The price of the Sea Hawks is given as about £5 million and of the Gannets about £2,500,000.

Luftwaffe Thunderstreaks

ON November 13 the West German Air Force received its first operational jet aircraft, when twenty F-84F Thunderstreaks bearing German markings were handed over by the U.S. Ambassador, Mr. Conant, to the 32nd Fighter-bomber Squadron at Fürstenfeldbruck, Bavaria.

Costly Error

AN F-80 ran into two parked B-47s on landing at the Lincoln, Nebraska, U.S.A.F. base on November 17. The pilot, who had apparently mistaken a taxying area for a runway, was killed and all three aircraft were destroyed in a fire which followed the accident. Seven airmen who had been refuelling the bombers were injured, one of them seriously, and the damage has been estimated at about £2,143,000.

United Aircraft Tunnels

THREE new blow-down tunnels are at present being constructed for the Research Department of the United Aircraft Corporation, of East Hartford, Connecticut. They respectively cover the Mach number ranges 0.5 to 1.5, 1.5 to 5 and 5 to 10. Construction started in 1955 and all three are now about to begin operations. They will be used to support developments undertaken by the Corporation's three major divisions (Pratt and Whitney, Hamilton Standard and Sikorsky) and will also be available for outside work.

Angels Zero

AT Yvetot, Normandy, a captive balloon surmounted by a platform has been used for painting the ceiling of a newly-built church. Borrowed from the French Army authorities, it enabled the painters to attain their operational ceiling without the aid of scaffolding.

Luton Promotion

APPOINTED chief technician of Hunting Percival Aircraft, Ltd., early in 1955, Mr. A. J. K. Carline is now made deputy chief designer.

Avro Appointment

SUCCESSOR to Mr. Philip Kidson as publicity and public relations officer of A. V. Roe and Co., Ltd., is Mr. John R. Gray, D.F.C. During the war he served

Mr. Gray.

as a Lancaster pilot in No. 3 Group, Bomber Command, attaining the rank of squadron leader. After demobilization he joined the General Electric Co., was later with Saunders-Roe, Ltd., and for the past three years has been with Mirrlees, Bickerton and Day, Ltd.

Mystery Still Unsolved

AN unsuccessful search by 80 men has been made in Endeavour Inlet, Marlborough Sounds, New Zealand, for the wreckage of a Ryan monoplane thought to have crashed there 28 years ago. It was being flown by Capt. George Hood and Lt. John Moncrieff in an attempt to make the first aerial crossing of the Tasman Sea. They left Richmond, New South Wales, hoping to land at Trentham Racecourse, Wellington, but were never seen again.

Delta Lecture Postponed

THE Royal Aeronautical Society lecture on "The Fairey Delta," due to be given on December 4 by Mr. R. L. Lickley, F.R.Ae.S., and Mr. P. M. Twiss, A.F.R.Ae.S., has had to be postponed to a later date, which will be announced.

Extra-Mural Study

A PARTY of nearly 50 schoolteachers recently visited Handley Page, Ltd., at Cricklewood and Radlett. Among the departments inspected were the structural spot-welding department, the high-speed tunnel, the apprentice school and the flight sheds.

Gabizo Test-bed

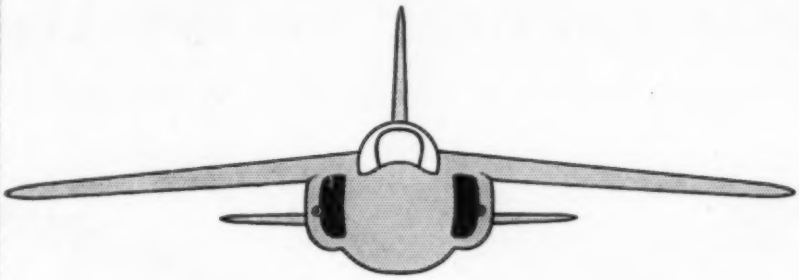
PILOTED by Léon Bourriau, the Fouga CM.171 Makalu recently made its first flight. The Makalu is a test-bed for two Turboméca Gabizo turbojets, each of 2,400 lb thrust. Over five hours' flying have already been completed, and on one occasion, from "brakes off," the Makalu attained a height of 40,000ft in 9 min 20 sec.

Aero Club Ball

A NEW Year's Eve Ball at Londonderry House is to be held for members and associate members of the Royal Aero Club and guests from 9.30 p.m. to 2.30 a.m. on December 31. Tickets, price 45s each (including buffet supper), from the Secretary-General, Royal Aero Club, 119, Piccadilly, London, W.1.

R-Theta Order

A CONTRACT worth $3m for R-Theta navigation computors to equip all R.C.A.F. CF-100 intercepters has been placed by the Canadian Department of Defence Production with P.S.C. Applied Research, Ltd., of Toronto. According to an official of the company, tests are being made to evaluate the computor for use in tanks and ships.



Now FINLAND ORDERS THE GNAT

THE GOVERNMENT OF FINLAND, LIKE THAT OF INDIA, HAVE CHOSEN THE GNAT FOR THE RE-EQUIPMENT OF THEIR COUNTRY'S AIR FORCE.

This light jet fighter — half the size, a third of the weight and needing less than half the thrust of the conventional fighter — makes big savings in initial and operating costs yet matches the conventional fighter in the nature and duty of its essential equipment and in flying and fighting performance. In some respects — e.g., in rate of climb, manœuvrability and maintenance — it has conspicuous advantages.

FOLLAND *Designed and Built by the Pioneers of the Light Jet Fighter*

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In World Wide Use . . . THE NON-DIRECTIONAL BEACON

The medium frequency Non-Directional Beacon is the most common form of radio navigational aid. Such beacons are used extensively for homing, holding, and approach procedures and contribute greatly to safe and punctual air services. Marconi beacons mark many of the world's major air routes and aerodromes. They are generously rated and designed to conform to I.C.A.O. standards.

3.3kW MF BEACON TRANSMITTER

TYPE WB 8

A high power beacon suitable for long range use on air routes crossing large sparsely populated areas or wide expanses of water. It is also useful where a high output is necessary to combat the atmospheric noise level.

250W MF BEACON TRANSMITTER

TYPE AD 501

This is a medium power beacon suitable for most purposes. It is equally useful for homing or holding at an aerodrome, or as a reporting point along an airway.

20W MF BEACON TRANSMITTER

TYPE AD 511

Designed for all short range functions connected with an airport such as holding, runway location and short range homing.

Marconi's expert advice, based on wide experience, is available on the particular type of installation suitable for any individual airport or route. Complete systems can be engineered from start to finish.

More than forty Airlines and twenty Air Forces fit Marconi air radio equipment. Marconi airport installations are in use throughout the world.

Lifeline of Communication

MARCONI

Airport and Aircraft Radio Systems

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX

LA 22

High-performance Instrumentation

Appropriate Equipment for a Mach 2 Fighter: A Pilot's Suggestions

By MICHAEL MORSS

FIGHTER pilots have for some years been complaining that their flight instruments are inadequately scaled for the performance of their aircraft. For example, dissatisfaction has often been expressed with the vertical speed indicator, which, scaled to measure rates of climb and descent to only 4,000ft/min, is invariably found to have its pointer stuck fast against one stop or the other, or else fluctuating wildly between them. Other flight instruments have been criticized for illegibility, despite modern improvements in dial-face styling.

In very-high-performance aircraft of the future—say rocket fighters capable of Mach 2 in level flight—such faults will be overshadowed by the fact that orthodox methods of presenting flight information will in any case be of very little use for indicating flight-paths and attitudes.

Faults in presentation are already apparent in the standard blind-flying panel. Some instruments, such as the airspeed indicator, are a legacy from test instrumentation, and are of little value in applied flying in a fighter. Others demand co-ordination with clock readings before they can be utilized: the rate-of-turn indicator is an example. Flight paths—the desired end-products of instrument flying—accordingly have to be translated beforehand in terms of information from the standard instruments. Direct readings are valueless by themselves.

The principal defect of the blind-flying panel, however, is that instrument flying is only comfortable—or, indeed, possible—in moderate attitudes. As soon as bank angles exceed 60 deg, and pitch angles 20 deg or so, a sense of impending loss of control overwhelms the pilot, and he hurriedly returns to more normal attitudes. It is obvious that if the full potential of a high-performance aircraft is to be realized, then new instruments must be devised which will allow safe and comfortable flying in what have hitherto been regarded as extreme attitudes.

It is, of course, one thing to say we want such and such an instrument, and another thing to design it and make it work. However, one cannot, as an idealist, pay overmuch attention to the niceties of instrument design; when, therefore, this article suggests instruments which will obviously require a greater or lesser amount of computerage before they will function, readers will forgive me if I pass to others the practical problems of development. Nevertheless, the majority of the instruments visualized are not, I hope, beyond the capacities of our instrument designers.

The Mach 2 Fighter.—It will first be helpful to enlarge on the probable performance and associated flight attitudes of a rocket fighter. On a normal sortie, we would take off, climb initially at subsonic speed to near the tropopause, accelerate in a slight dive to a supersonic climbing speed, and thereafter climb supersonically. After the cruise and combat, the descent would be steep from high altitude to near the let-down pattern entry height. Final approach attitudes would be moderate. Splitting the flight up into stages, we have:—

(1) *Subsonic climb* initially at say M = 0.95, reaching 40,000ft in 2 min. Climb angle, about 30 deg.

(2) *Acceleration to supersonic climb:* The aircraft will bunt from a climb to a dive angle of 10 to 20 deg.

(3) *Supersonic climb:* With a rocket fighter, where the thrust does not fall off with altitude, and taking into account zoom climbs, the attitudes to be expected may be anything from near level to practically vertical.

(4) *Cruise at altitude*—of short duration; the pilot will be occupied with navigation, and possibly with a pursuit-course or collision-course attack on a target.

(5) *Initial descent:* Given powerful airbrakes, the fighter could come vertically downwards to a reasonable height.

(6) *Final approach*, at attitudes considered normal today. With a rocket fighter, the landing weight will be considerably lower than the take-off weight, and the stalling speed at landing will thus be considerably lower than at the start of the flight.

The Standard Blind-flying Panel.—From the foregoing it is apparent that the pilot of a Mach 2 fighter will spend a considerable part of each sortie in attitudes which would be described today as aerobatic flight. Few would care to attempt controlled instrument flying in such attitudes; and there are even fewer instruments on the contemporary blind-flying panel which would allow such an attempt.

The instruments on the present panel can be divided into two broad groups, covering performance and attitude respectively:—

Performance: *Airspeed indicator*—indication of dynamic air pressure (calibrated in knots). *Machmeter*—speed as a fraction of the speed of sound at the height at which the aircraft is flying. *Altimeter*—pressure height of the aircraft (calibrated in feet). *Vertical speed indicator*—change of pressure-height (calibrated in feet per minute).

Attitude: *Artificial horizon*—angle of bank (scaled), and pitch angle (unscaled). *Turn and slip indicator*—records horizontal angular velocity of the aircraft (calibrated in rates of turn: Rate 1 turn equals 3 deg/sec. Also records angle of yaw, unscaled). *Compass*—records heading of the aircraft.

THE author is a test pilot with the Gloster Aircraft Co., Ltd. After leaving the Royal Air Force he was engaged on technical duties at the A. and A.E.E., Boscombe Down. He joined Glosters in 1955 and now has some 1,400 hours' flying experience. In this article, after criticizing contemporary flight instruments with the next generation of fighters in mind, he outlines improved equipment to replace them. His suggestions are his own and do not take into account research which is now producing a totally new instrument system, some components of which have already been publicly shown.

The Performance Instruments.—Because of the nature of a fighter's duties it is desirable that the pilot should have to look at his instruments as infrequently, and for as short a time, as possible; the performance instruments should therefore give information which he can use straightaway, without any calculation. In this respect the airspeed indicator is noticeably lacking.

Airspeed Indicator and Machmeter.—The dynamic pressure of the air is directly proportional to the indicated air speed, and its value is thus of great interest to aerodynamicists and designers. Few pilots, however, are much concerned with the airloads on their aircraft; their main preoccupation is with their speed through their environment, and also their proximity to the stall. Unfortunately, the A.S.I. indicator is of limited use for either purpose. For navigation, where the true air speed is required, the A.S.I. reading is valid only at sea level. As height is gained, an increasingly large density-correction has to be applied—e.g., at 40,000ft the T.A.S. is approximately double the I.A.S. In addition, a compressibility correction must be applied to the instrument in current use; this correction increases with speed and height.

Now let us consider the possible uses of the machmeter. It was originally installed in high-speed aircraft to give warning of the approach of violent and possibly dangerous compressibility at sonic speeds; this was its sole function. But with an aircraft capable of Mach 2 in level flight the passage through the transonic region should be quite smooth, whether by virtue of the aerodynamic shape or by reason of internal palliatives. The machmeter in such an aircraft would therefore be of limited value, and the only possible excuse for its retention would be to indicate the transonic drag rise for climb and cruise purposes.

There is, however, another and more important use for which it could be readily adapted, and that is as a true air speed indicator. The present machmeter is already used by many fighter pilots as a crude T.A.S. meter. Multiplied by ten, the reading on the machmeter dial (say M = 0.7), gives the true air speed in nautical miles per minute (in this case, 7 n.m./min). With the present instrument this method is only strictly accurate at around 26,000ft in the I.C.A.N. Temperate Atmosphere; but with compensation for temperature, the reading would be accurate for all heights. If the machmeter were converted to a T.A.S. meter the readings could possibly be retained in nautical miles per minute, because fighters seldom fly in one direction for more than a few minutes at a time, and calculation of distance gone would be a simple matter of multiplying the T.A.S. meter reading by the number of minutes. The total endurance of the fighter might well be less than one hour, in which case the number of nautical miles capable of being flown in one hour is of only academic interest.

If, then, it is possible to transform the machmeter into an accurate speed meter, we can separate the speed measurement function of the airspeed indicator from the stall indication function, and develop the latter so that it will be accurate in all conditions. This could best be done by throwing the instrument away altogether, and replacing it with an angle-of-attack indicator. Stalling speed, as a figure on the A.S.I. dial, is accurate only for one particular weight, and for unaccelerated flight only; as soon as g is applied, the stalling speed rises in proportion. Stalling speed is, however, a function of wing angle of attack, neglecting compressibility. With an angle-of-attack meter showing the amount of life reserve available in any condition, approaches would be made in greater safety, and tighter circuits performed with confidence; at altitude, although the instrument would

HIGH-PERFORMANCE INSTRUMENTATION . . .

require a correction for compressibility effects, it would show the lift-reserve in turns.

A possible combination of these two instruments, T.A.S. meter and angle-of-attack indicator, is shown in Fig. 1. The scales of the two dials should be close together because, at the approach to the stall, especially at circuit level, there would be frequent cross-reference; as speed was reduced, the pilot would refer increasingly to the angle-of-attack indicator to see by how much more he could safely reduce his T.A.S. The scale of the angle-of-attack indicator is shown upside down; but this is the most natural position, because the instrument would be treated primarily as an indication of reserve of lift, i.e., angle yet unused; and the lowest reserve

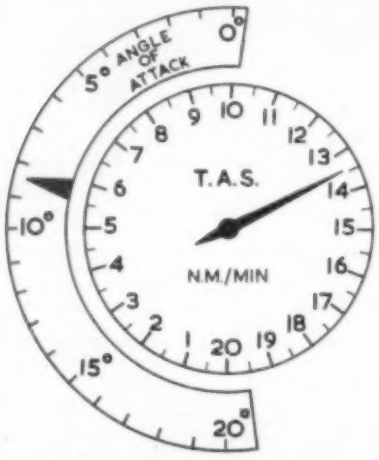

Fig. 1. Combination of true-airspeed meter and angle-of-attack indicator.

is, of course, at the base of the instrument. The angle at which the stall occurs could be arranged to be adjacent to the mean straight stalling speed, at sea level and a given weight, as it would be on the T.A.S. meter.

The Altimeter and Vertical Speed Indicator.—The altimeter must remain much as it is at present, although it would be better to have a counter presentation for the thousands of feet, and a single pointer for the hundreds. No flight instrument should have more than one pointer needle; if the scale has to be split for increased accuracy, then the larger units should be displayed in numerals in a counter window. Fighter pilots never have spare time for differentiating between two or more scales and pointers on the same dial. Instruments which are prone to misreading will be misread; and few arrangements have such a record of misinterpretation—sometimes with disastrous consequences—as that of the three-needle altimeter in current use.

Altimeters with counter presentation have been produced, and a typical arrangement is shown in Fig. 2. The pointer scale starts next to the counter window, so that, as the pointer moves past, the numerals increase or decrease as appropriate.

The vertical speed indicator is rather a mixture. While it is undoubtedly a performance instrument, it is more usually used as

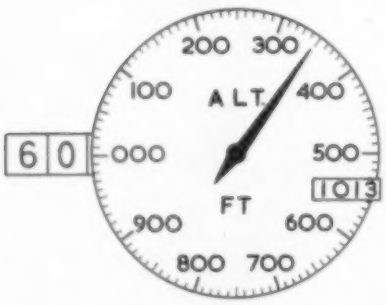

Fig. 2. Altimeter, with counter presentation of thousands of feet and millibar setting.

an indication of whether or not the aircraft is maintaining a level, or slightly inclined, path—in other words, it is used to back up the artificial horizon, which has a vague and ambiguous presentation about small angles of pitch. It is better, therefore, to consider the vertical speed indicator as an attitude instrument.

The Attitude Instruments.—In controlling the attitude of an aircraft, we are concerned with two things: motion in the pitching plane, and motion in the rolling and yawing planes. In jet (and rocket) aircraft, where there is no asymmetry introduced by a propeller and its slipstream, there is no connection between the motions; and one tends to separate them, and deal with them separately—that is to say, not concurrently, but with a definite interval between them. If we accept that this is so, then it would be convenient to make a similar division in the presentation of information dealing with the motions: all the information dealing with the pitching plane would go on one instrument; and all that dealing with the rolling and yawing planes would go on another. In practice, this would separate the contemporary instrument as follows:

Pitching Plane.—Pitch indication of artificial horizon; vertical speed indication.

Rolling and Yawing Planes.—Bank indication of artificial horizon; turn-and-slip indications; compass indication.

Such an arrangement would, of course, split up the artificial horizon, so that there would be nothing left which could justly be referred to by that name. The acceptability of this is debatable. Can we throw the artificial horizon out of the window, and yet retain on the flight panel the basic necessities for instrument flying?

This raises two further questions. First, is the artificial horizon capable, as an instrument, of being developed to give sufficiently precise indications of pitch angle (of sufficient range) to meet the demands of a Mach 2 fighter? Secondly, is it necessary (whatever the answer may be to the first question) to retain this semi-pictorial presentation of the view from the cockpit, merely to keep the pilot happy when flying on instruments?

After much reflection I am firmly of the opinion that the fundamental requirement of a blind-flying attitude instrument is that it should give the pilot an accurate *mental* picture of his situation; it is not necessary for it to give him a pseudo-visual one. How this mental picture is obtained does not matter, so long as the process is easy, and the result precise and unambiguous.

The artificial horizon is easy enough to understand, but it is neither unambiguous nor precise; and because of this it fails to do its intended job properly. Most pilots will agree that the current artificial horizons are seldom referred to except as a rough check that one is in a reasonable attitude. One never attempts to continue flying on the instrument once bank angles exceed 60 deg, or the model aeroplane is separated from the horizon by half an inch or more; when these two conditions are present simultaneously, the instrument looks like a couple of crossed sticks, and the pilot is never really happy until he has removed the bank and restored the model to the horizon. In fact, the instrument is only trusted for pitch angles when at zero bank, and for bank angles when at zero pitch. This distrust is most noticeable when large pitch angles are displayed, and the reason is not hard to understand.

Let us return for a moment to visual flight. The visual horizon itself is no use for reference in the extreme attitudes of a high-performance aircraft. If, say, the aircraft is in a zoom climb at an angle of 60 deg, the pilot does not refer to the horizon straight ahead for his position, because (a) he cannot see it, and (b) even if he could, he would be unable to judge his angle to it. The only way he can do this is by looking sideways, as he would do in aerobatics or ground attack. One measures an angle not by standing at the corner of the angle and looking at the space between the two sides, but by removing oneself to one side and looking at the angle in elevation.

The attempt to re-create visual conditions in an artificial horizon must always have psychological limitations, because the human being is unwilling to try to judge the size of an angle from a position at the corner. The artificial horizon could, of course, be given a scale for pitch, but the presentation would still be conducive to a feeling of insecurity at large pitch angles.

The logical extension of this argument is to have an instrument which will present pitch angles to the pilot as he would see them from the side. This proposal will certainly be viewed with horror by the school of thought which maintains that the pilot must be given a representation of the view through the windscreen, such a view being deemed necessary for the frequent periods of transition between instrument and visual flight—as, for instance, when flying through broken cloud. A different sort of picture or presentation would, it is said, tend to confuse the pilot by not preparing him for the scene as it is suddenly revealed to him when he breaks cloud. (I can never understand, by the way, why the picture is not presented as a view of the horizon through a model windscreen, and not as a model aeroplane manœuvring about a horizon. This latter presentation never seems to have made up its mind between inviting the pilot to behave as if he were in the cockpit, or to act as if he were following behind). However, if one has a complete mental picture of one's position, there cannot be confusion, because there is no conflict of ideas. Confusion is much more likely to arise with a presentation which panders to

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This is an electronic analogue computer, designed and built by ENGLISH ELECTRIC for work at their Aircraft Division's Research establishment at Warton on problems of aircraft flutter and stability. A mathematician with a desk calculator would find it fairly easy to solve problems of flutter in two degrees of freedom, very difficult to solve problems in three degrees of freedom, and impossible to go further. This machine solves, in a few minutes, problems of flutter in six degrees of freedom. This does not mean that the mathematician becomes redundant. To produce the figures for a family of problems for the computer to work on may easily take him a fortnight. The computer then does in an hour or so what would take the mathematician 6 months to do—supposing he could do it at all.

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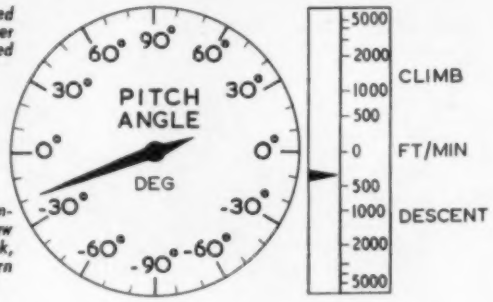

Fig. 3. Combined pitch-angle meter and vertical-speed indicator.

Fig. 4. (Right) Combined compass, yaw meter, angle-of-bank, and radius-of-turn indicator.

the seat of the pilot's pants (as the artificial horizon does), because this tends to prevent him taking a detached appreciation of his position. Instrument flying is—or should be—a completely intellectual exercise.

Pitching motion.—Having decided to separate the pitch indication of the artificial horizon, and present it sideways, we might arrive at an instrument layout as shown in Fig. 3. A needle rotates on a scale of pitch angle which ranges through the entire 360 deg; thus an aeroplane doing a loop would cause the needle to go completely round the scale, and the pilot would know his angle to the horizon at every stage. If the instrument was derived in the same fashion as the artificial horizon, then there would be an error at large angles of aircraft incidence (i.e., low speeds), where the aircraft might be losing height while still showing a positive pitch angle. To enable the pilot to check that this was not happening, the vertical speed indicator would be put immediately adjacent, as shown in illustration. These two instruments should always be put close together; and it would be even more desirable to go the whole hog and have the gyro-operated pitch instrument monitored by the vertical speed indicator, in much the same way as a directional gyro is monitored by a magnetic compass to give a gyro-compass. The readings from such an instrument would give true flight-path angles, and be completely independent of aircraft incidence. As most flying would be done between the pitch angles of plus or minus 30 deg, the instrument could be provided with a logarithmic scale, so that over the small pitch angles (as, say, on a G.C.A. glide-path) the pilot would have a wide and accurate scale to fly on.

Rolling and Yawing Motion.—We are finally left with the information dealing with roll and yaw, to be combined, if possible, on one instrument. Before this is done, it is desirable to remove the *rate* of turn instrument, and replace it with one giving *radius* of turn. Rate of turn—in other words, angular velocity—is of interest to the scientist, but not to the pilot; and it is not, in any case, of practical use until it is combined with the readings from a clock, to give the angle turned through—something which is done far better by the gyro-compass. Radius of turn, in contrast, is of immediate application in navigation, blind circuits, and interceptions at altitude. As it is a function of true air speed and g, it can be derived from the instruments giving these values; some compensation would, of course, be necessary to make the radius apply only to the horizontal plane.

We have, then, the following items: bank indication of the artificial horizon; radius of turn; yaw meter; and compass. The first three could possibly be combined within the framework of the compass rose. The yaw meter should be put near the top, so that the pilot can see if he is turning without yaw. (Well-designed aircraft should turn on ailerons and elevator alone, so that there should be no need to check for yaw in a turn; but if there is a need to check, then this is the best place to do it.) The angle-of-bank indication, exactly the same as that on the artificial horizon, but fixed on the horizon, would go in the centre, and the radius of turn at the bottom, with a logarithmic scale. The arrangement is shown in Fig. 4 above.

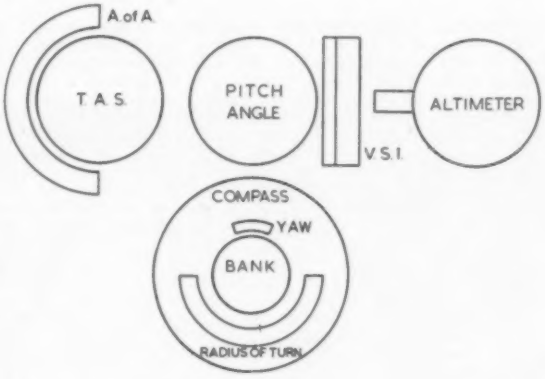

Fig. 5. Suggested arrangement for the complete panel.

The Flight Panel.—Having evolved a series of more or less novel instruments, it remains to dispose them on a panel, in order that they may be used with maximum ease and value. Several arrangements are possible, but the one shown in Fig. 5 would probably be the best. The instruments dealing with flight in the pitching plane are laid out in a row along the top; the compass and its associated instruments below, in the centre. The pitch instrument goes in the centre, above; the speed instrument to the left; the vertical speed instrument adjacent to the pitch instrument; and the altimeter next to the vertical speed indicator.

All that is finally required is a U-shaped control-stick top so that the pilot can see all his instruments without having to sit on one side of his seat.

BETTER-KNOWN UNKNOWNS

MORE nonsense has been talked and written about so-called flying saucers in recent years than about almost any other subject. A relative measure of the nonsense—or, at least, an indication of the margin of error—is that some 85 per cent of reported sightings of unusual airborne objects in the U.S.A. were found to have rational explanations, according to an extended U.S.A.F. investigation. It is the remaining 15 per cent that are interesting.

A number of the more important sightings among this 15 per cent are detailed in the United Artists film *Unidentified Flying Objects*, recently shown at the London Pavilion and now generally released. The film traces the progress of the various U.S.A.F. investigations—Projects Sign, Grudge and Bluebook—as they affect an information officer concerned with them at Air Materiel Command headquarters and at the Pentagon. It is documentary in treatment, and many of the persons involved are in the film.

Also included are two lengths of colour cine film, taken in Montana and in Utah, showing small white circular objects flying across the sky, and a re-enactment of an actual incident when "Unknowns" over Washington were observed for six hours on a radar screen, as well as by the pilot of an intercepter aircraft. This pilot was not the only one to have reported sighting U.F.O.s; among several such incidents depicted in the film is an occasion in 1948 when a National Guard aircraft crashed after its pilot had sighted and pursued one of the objects.

At a U.S.A.F. press conference following the Washington incident, it was stated that there were "credible observers of relatively incredible things." While not suggesting what the unknowns are or where they come from, the film tells the story of what has been reported, and investigated, during the past nine years. Considerably more restrained then the type of film usually presented at the London Pavilion, *Unidentified Flying Objects* is produced by Clarence Greene and directed by Winston Jones. It will give a lot of people a lot to think about.

K. T. O.

An artist's impression of the MD-12 light transport, now under construction.

By J. B. CYNK

Part II

THIS article—Part I of which appeared last week—was written before the recent political events in Poland. It should, therefore, be read with the proviso that the Polish aircraft industry may now be at the beginning of a new era, less subject to Russian control. In this second instalment the author describes progress since 1950.

POLISH AIRCRAFT DEVELOPMENT

SEVERAL important events in aviation took place in Poland at the end of 1950. At that time a "reorganization of the aircraft industry" was proclaimed almost simultaneously in various of the Soviet-bloc countries. The purpose of it was to adjust production resources of the satellite states to the needs of Russia's strategy and economy, and to put them under the absolute control of the Soviet war machine; it was, in fact, the Soviet reply to NATO. Aircraft factories in east European countries were vastly expanded and some new plants built. Several important types of Russian military aircraft were put into mass production. Thus Russia gained new production centres of great strategic value, which further assisted the decentralization of the Soviet aircraft industry. In Poland, the largest P.Z.L. factories began tooling-up for production of Mig-15bis fighters, and the first Polish-built aircraft of this type were delivered from the factory at Mielec during 1953. It is estimated that between 500 and 700 of these fighters have been produced up to the present time. It is also believed that the first Polish-built Il-28 bombers were recently delivered to the Polish Air Force.

Although this reorganization greatly increased the production capacity of the Polish aircraft industry, it has, at the same time, brought progress in national designs to a complete standstill. L.W.D. and C.S.S. were dissolved and their design offices closed. This was a thoughtless policy, which did the Polish design effort great harm, and its effects will be felt for some years to come. Work was later resumed on the production of the Junak but progress has been very slow, deliveries only starting at the beginning of 1954.

The first S.M.1 helicopter, completed in May of this year.

In 1952 the leading Polish designers formed a small design office at I.L. (Aircraft Institute, formerly G.I.L.), with T. Soltyk as chief designer. Work on the T.S. 8 Bies trainer then began, and it was flown for the first time on July 23, 1955. This aircraft, described later, was the first new Polish machine built since May 1951.

Some light has recently been thrown on the conditions under which designers have been working in the satellite states. Reports were published in the journal *Skrzydlata Polska* concerning discussions in aeronautical circles, which reveal that there are no modern wind tunnels and no engine test-beds in Poland. Equipment and aircraft used for instructional purposes in the technical institutes and colleges date back to the 1940-43 period. Only in photographs does more up-to-date equipment appear. The number of foreign technical publications available in Poland has this year been cut by 75 per cent. Students wishing to fly or to study aircraft engineering automatically come under suspicion and, after exhaustive security checks, only reliable Party members are allowed to begin studying. Several specialists and people of exceptional ability in aviation have been relegated to factories building agricultural machinery or other light engineering products.

The result of this policy is that the aviation industry is full of trustworthy Party members, but their knowledge and experience is inadequate, and their real interest is not in aeronautics. "They may sit by the open window, but they are not eagles—they cannot fly," one of the critics of this system has said. Production of obsolete Russian aircraft under licence has been openly condemned. The training of flying personnel has also been criticized, because the main concern of instructors and schools is the "mass production," in the minimum time, of the number of trained pilots required; their real experience and knowledge of flying being of secondary importance. Several serious accidents have occurred as a result. Conclusions reached after many discussions have been presented to the Government, and it is hoped that action will be taken to improve the situation.

Re-emergence of Polish design. In 1955, in line with the "new look" of Soviet policy, a change of spirit in the Polish aviation industry became apparent. The C.S.S.12 and the Zuraw, which had been standing idle in hangars for over four years after only brief preliminary flights, were taken out and put through a full test-flying programme. As a result, a new twin-engined feeder-liner, designated MD-12, and designed by Misztal and Duleba, has been developed from the C.S.S.12 and is now under construction. An order has already been received from the national airline, LOT. This machine is powered by two of the new Polish-designed WN-3 radial engines of 320 h.p., and features a "T"-type tail unit.

The Zuraw 2, also with a WN-3 engine, is now under development as a glider-tug. The estimated all-round performance of this version is considerably better, with a maximum speed of over 170 m.p.h. At the end of last year a light monoplane with a tricycle undercarriage, resembling the Ercoupe, and designated the Czajka, was built by private effort.

The new four-seat automatically stabilized BZ-4 Zuk heli-

[*Cont. on p. 815*

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POLISH AIRCRAFT DEVELOPMENT . . .

copter was shown in public for the first time on Polish Aviation Day (August 26, 1956). This design by B. Zurakowski has a specially adapted WN-3 engine.

Design studies for a national supersonic fighter are under way. The fuselage of the proposed machine resembles that of the Bell X-1, and ends in a long needle nose. The wings and tail unit are very similar to those of the Mig-15, and the large wing-root air intakes resemble those of the F.D.2 There are also design studies for a light jet trainer.

This year, at the July Poznan Fair, the T.S.8 Bies was shown in public for the first time (the machine on show was the third prototype). This design was developed from the previous L.W.D. project of the same name, and the aircraft first flew on July 23, 1955. It has now successfully completed its test-flying and will shortly go into production.

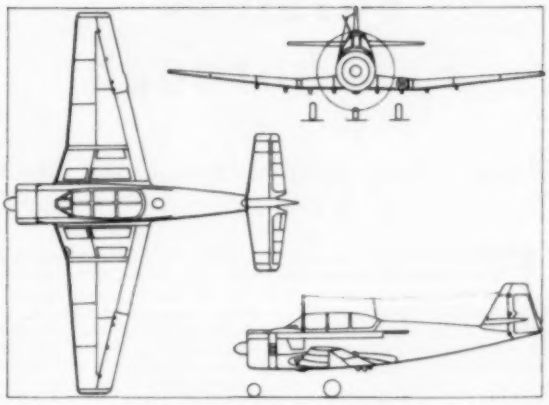
The Bies is an all-metal two-seat fully aerobatic basic trainer of low-wing cantilever monoplane layout. The wings, of NACA 23012 section, are thickened in the centre to 13 per cent. They are in three parts, comprising a centre section integral with the fuselage, and two trapezoidal outer sections. The centre section has a stressed skin and a main spar with heavy duralumin booms which pass through the fuselage, and bend back and down at the first rib, continuing to No. 4 rib. This forms the back wall of the torsion box, the heavy gauge reinforced skin completing the D-section. This shear is gradually transmitted from the spar into the skin in that portion of the wing.

Both outer wing sections are of conventional stressed-skin construction, transmitting all the air loads by skin-stringer combination, without heavy spars. Between the differential ailerons pneumatically operated slotted flaps are fitted. Their hinge axes are situated rather low, and the three standard positions are: closed, partly open (15 deg) for take-off, and fully deflected (45 deg) for landing. The construction of flaps and ailerons is similar, both consisting of a thin-walled steel tube along the leading edge—thus improving the static balance—and a number of duralumin ribs, the whole being fabric-covered. A landing light and camera are incorporated in the port centre plane, near the junction with the outer wing, and a pitot head is mounted at the tip of the starboard wing.

The elliptic-section stressed-skin fuselage is reinforced round the cockpit cut-out with heavy-gauge longerons. Three vertical partition walls running in the longitudinal direction are provided under the cabin floor. Two of these, extending from the first fuselage frame to the wing spar, divide the front wheel-well from the front fuel tanks, which are placed on either side. The third partition, starting at the spar, forms a wall of the rear fuel tank, occupying space to the left, whilst major auxiliaries and electrical components are housed in the right-hand compartment.

Two cockpit seats are provided in tandem, the front one for the pupil and the rear for the instructor. Both stations are provided with full set of controls and complete instrument panel, including blind-flying instruments, but the T/R. radio can be worked from the front seat only.

Tailplane and fin are built on the single-spar torsion-box principle, and both elevators and rudder are of the same construction as the ailerons. A trim tab, which is adjustable from the pilot's seat, is provided on the port elevator; but the tabs on the rudder and ailerons can only be set on the ground.



General arrangement of the T.S.8 Bies.

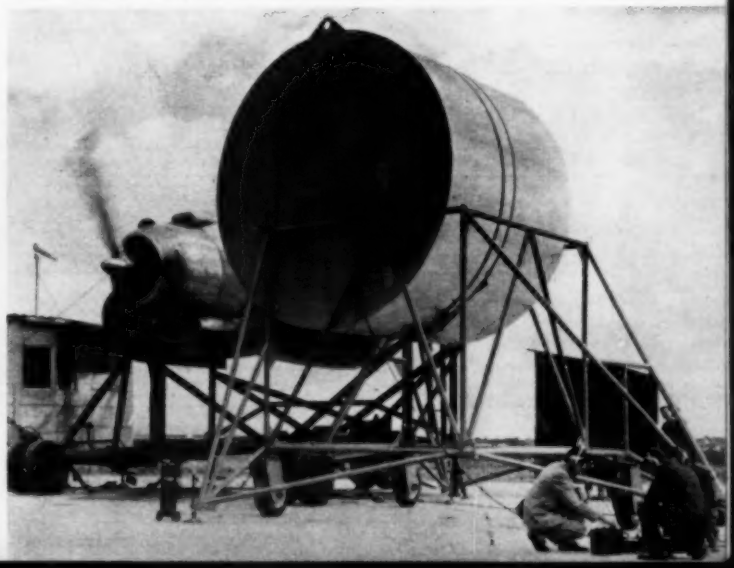
The powerplant of this aircraft consists of the new Polish WN-3, which was designed by W. Narkiewicz. It is a seven-cylinder radial air-cooled engine rated at 320 h.p. at 2,350 r.p.m., with maximum emergency power of 340 h.p. at 2,500 r.p.m. A two-blade constant-speed wooden propeller is fitted to the first prototype, but production Bies will be equipped with the new Polish-designed variable-pitch constant-speed assembly. The third prototype, which was shown at the Poznan Fair, is experimentally fitted with a variable-pitch propeller by Hamilton Standard. The total fuel capacity is 48.3 Imp. gal. Span is 34.44ft, length 28.05ft, height 9.84ft, wing area 205.59 sq ft, weight loaded 3,417 lb, maximum speed 192.6 m.p.h., cruising speed 161.5 m.p.h., ceiling 19,685ft, and range 435-500 miles.

Two Russian types were recently put into production, mainly to avoid closing down some factories. These are the Yak-12M and the Mi-1T, designated SM.1 in Poland, and intended for large-scale export to Arab countries. Some factories which were engaged on mass production of Mig-15s are now re-tooling for the SM.1 helicopter and motorcycles. Two new versions of the SM.1, for ambulance and agricultural duties, will go into production by the middle of next year.

It appears that production of first-line military types has been seriously curtailed, and factories have plenty of floor space for other work. Although it is not possible to say yet whether a radical change in conditions facing designers in Poland may be feasible, it is possible that the recently renewed activity in the aeronautical field will have better results than it did in the immediate post-war period.

CANADIAN RESEARCH AND DEVELOPMENT: TWO NEWS-VIEWS

The picture on the left shows a Bristol Sycamore which is to undergo rotor-blade de-icing tests in the steam-spray rig at the National Aeronautical Establishment, Ottawa, in order to evaluate the Goodyear de-icing equipment under consideration for the Bristol 192 (see p. 752, "Flight," November 9); the device mounted above the hub is a cyclic switch to distribute current supplied from a ground source. On the right is seen a ground-running development rig for the Wright Turbo-Compound installation of the Canadair CL-28. The engineers are measuring noise levels in the adjacent portion of fuselage (a low noise level is important for crew comfort on long missions).



Farmers' Farnborough

World's First Aviation Agricultural Show

THE world's most recent developments in agricultural aviation were seen at Milson airport, Palmerston North, New Zealand, on November 9 and 10, when the first International Agricultural Aviation Show was held. More than 200 aircraft of 21 different types were on view, and 61 top-dressing machines put on the biggest civil formation fly-past yet seen in Australia or New Zealand. Visitors included scientists attending the International Grasslands Congress held concurrently in the same city; altogether, over 40,000 people attended.

Though the airport show and static displays gave visitors an idea of the variety of aircraft and equipment available, the more practical demonstrations were given at a farm about ten miles from the city, where a display of fence-dropping and top-dressing, dusting and spraying in typical foothill conditions was watched by about 4,000 people. Here under conditions which were not ideal, operators put the aircraft through their paces in these aspects of agricultural work. Pipers, Cessnas, Fletchers, veteran Tiger Moths, and a Bell helicopter all demonstrated their individual abilities. Of the varied performances, that of the Bell 47G was undoubtedly outstanding. At a working speed of about 25 m.p.h., the pilot displayed its possibilities in normally inaccessible places, manœuvring in and out of ravines and gorges, and spraying nine to ten gallons per acre.

With improved capacity, the Bell can now spray up to a maximum of 50-60 gallons per acre, and is doing so at present in New Zealand on gorse; but its high price and its operating cost of around £40 an hour make it a decidedly dearer proposition than many of the conventional aircraft which were on show. (It must also be remembered that in the matter of operating costs a good many agriculturists still think in terms of the Tiger Moths that have for so long been a mainstay of the industry.)

The Piper, Cessna and Fletcher—the last-named aircraft being numerically the most prominent type at the show—all impressed by their spraying operations. The D.H.C. Beaver and its high capacity were also seen to advantage, with a Lockheed Lodestar coming in from Milson to demonstrate the agricultural use of larger types of aircraft. It made three runs at about 145 kt, and showed an even distribution of fertilizer over a wide area.

The fence-dropping attempts showed accuracy of dropping and the general display was a decided success; but there were several aspects which did not fully convince the onlooker. Owing to the unfavourable wind direction, it was not possible to drop the material on the flagged sites by flying "into" the hill, so the aircraft flew across the targets in a direction which resulted in the posts and netting rolling down the slope rather more than might otherwise have been the case. The actual release of the material, from about 30 to 40ft, could not have been bettered; but though the ground was quite soft there were signs of the effect of the drop, and several fence-posts split on hitting the ground. It is apparent that a more satisfactory method of lashing the material will have to be devised.

There was unqualified praise for the spraying and dusting demonstrations, in which New Zealand was commonly mentioned as "leading the world." But none of the new aircraft took part in this display, which was the only real yardstick by which the performance of different machines could be measured. There was no more than a brief appearance of the latest types at Milson aerodrome.

Two recent British entrants in the field of aerial agriculture work in New Zealand, the Auster Agricola and the Edgar Percival E.P.9, attracted much interest from aircraft operators and from the general public. The revolving stands on which these machines were displayed assisted spectators in examining their external features. Because of bad weather, with rain, which curtailed the flying programme, it was not possible to see these two aircraft on top-dressing work. Incidentally, G/C. Douglas Bader, one of the official guests at the show, was particularly interested in the E.P.9, as he flies an earlier machine by the same designer—a Percival Proctor.

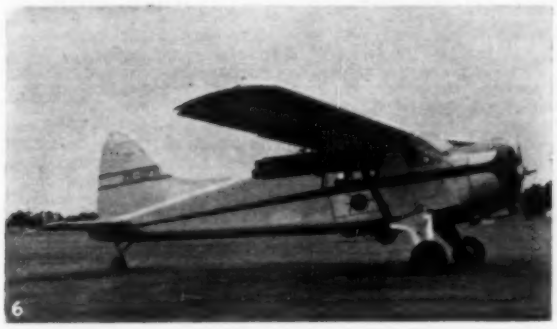
A spokesman of the organizing committee said after the show that it was likely to become an annual event, held in a different country each year.

The first show, and public interest in it, gave further proof of the expanding market for agricultural aircraft in New Zealand, where greater returns are being earned annually from the land through the increasing use of aerial farming, and thousands of acres have still to be brought into production by top-dressing. It is only seven years since the first commercial top-dressing job was done by the Brazier brothers on the Otahuna property of the late Sir Robert Heaton Rhodes; but since then, hill farming revenue has increased yearly through the use of aircraft; and the most serious national farming problem, erosion, has been successfully countered.

1 *Baling-out: a Cessna 180 releases stock-fodder from large under-wing cages.*

2 *Show-ground view, with Bell and Hiller.*

3 *Fletcher FU-24s outnumbered others.*



4 *The Edgar Percival E.P.9 shows its paces.*

5 *Also from England—Auster's Agricola.*

6 *Not warlike stores under a D.H.C. Beaver's wings, but heavy fence-posts.*

7 *Loading equipment—here seen filling a Beaver's hopper—was demonstrated.*

8 *Port under-wing tank and windmill-operated spray equipment on a Cessna.*

9 *Sunlight and superphosphate: a striking impression during one of the runs.*

10 *Off-stage at the demonstration farm.*

The lecturer (right) with Mr. N. E. Rowe, Blackburn technical director and president of Brough R.Ae.S. Branch.

Sir George Cayley Memorial Lecture

Mr. F. H. Owner on Engine Development

EACH year at Brough, the memory of Sir George Cayley, father of British aviation and one of the earliest researchers into the problem of aerodynamics, is commemorated by a lecture to the local branch of the Royal Aeronautical Society. In keeping with the spirit of the occasion, the lectures are largely retrospective in context and presented by authorities whose long experience specially qualifies them to both review past achievements and to determine the trend of development in the years ahead.

The lecture this year, entitled *A Survey of the Development of Aircraft Engines*, was to have been given by A. Cdre. Banks, but because of his unavoidable absence abroad the subject was tackled—extempore, yet with a most pleasing and eloquent fluency—at very short notice by Mr. F. H. Owner, C.B.E., M.Sc., F.R.Ae.S., M.I.Mech.E., the deputy chief engineer of the de Havilland Engine Co.

Recalling that Henry Ford had once said "history is bunk," Mr. Owner asked how else, except by a study of history, was it possible for the trend of events to be gauged?

He underlined his point by projecting a series of slides depicting the development of the turbine power unit. Discussing Hero's steam turbine of 150 B.C. he unwittingly gave his audience an insight into the inquiring mind of a senior engineer. The bearings of the chamber, he remarked, were apparently steam-lubricated—a concept that was now repeated in the modern practice of gas lubrication.

Surveying the historical background to the modern turbojet, Mr. Owner touched upon the accelerating development stages to which the turbine power unit had been subjected: Branca's first appreciation of the value of high turbine rim speed in 1629; Barber's realization of the necessity of cooling by water-injection in 1791 and the important patents on the Parsons gas turbine which were taken out in 1884. At the turn of the century the pace of progress quickened; Sir Charles Curtis had built a non-self-sustaining turbine with straight-through combustion, and a water-cooled axial turbine in 1894. This was followed by the Ammengaud and Lemale steam turbine in Paris—of about three per cent overall thermal efficiency—and the Karavoden and Hotsworth turbines as interesting variations on methods of compression.

In 1920 a considerable—if theoretical—advance into gas-turbine technology was made by W. J. Stern, whose report *The Status of the Aeronautical Gas Turbine* was one of the first investigations into the thermal and pressure cycles in a turbine, and reviewed the materials and stress levels that would be required in a 1,000 h.p. unit with a 7:1 compression ratio. But such an engine, the lecturer recalled, was dismissed as impractical until the time that better materials could be developed.

The next step forward was the result of Dr. A. A. Griffith's researches (he achieved a compressor efficiency of 90 per cent) into free-vortex theory in 1926. An engine based on this theory was the counter-rotating, counter-flow engine, examples of which were built by Rolls-Royce and Armstrong Siddeley in 1939. In this engine each compressor stage is powered by an adjacent turbine stage and the residual gases for jet propulsion are exhausted at the forward, intake end of the engine.

Perhaps it was this feature, and the unexpectedly high leakage losses which occurred between the compressor and turbine stages, that contributed to its demise: but a more potent factor was the advent of a new name and of new ideas. Frank Whittle's developments were beginning to overshadow every other project.

It is always interesting to hear the authoritative opinions of those who are able to pronounce on the abilities of great men. Mr. Owner knew Frank Whittle in the early 1930s and had studied the famous patent 347203 (a number, it may be added, that the lecturer required no notes to remember) which was taken out in 1930. It was Whittle, the lecturer said, who recognized that "the crux of the problem was to operate the turbine at a high enough temperature" and even at this time he was proposing the use of ceramic blades. It is to the lecturer's credit that he now readily admits that he was among those who scoffed—or at least was sceptical—at this idea.

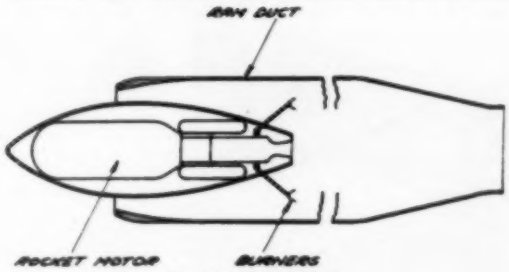


Fig. 2. Ducted rocket.

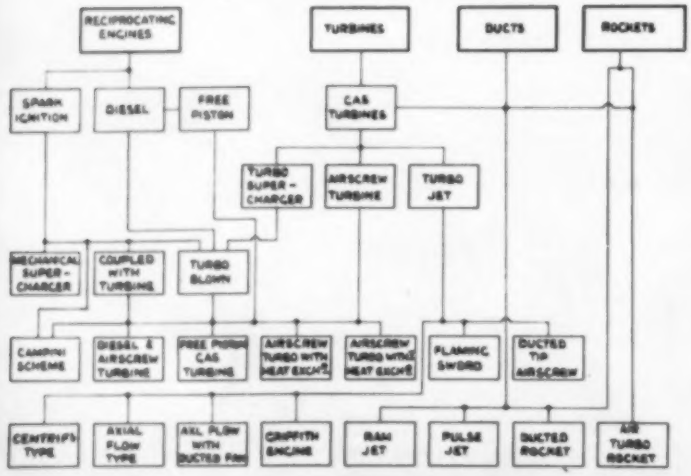
A new name to most of the audience was that of the Hungarian Jendrassik. Before the war this inventor had developed an aero engine with a ten-stage axial compressor giving a compression ratio of 2.2:1 and revolving at 18,500 r.p.m. The Campini jet was more familiar; although not particularly successful, this design—which made use of a reciprocating engine-driven compressor—was one of the very earliest to fly.

Wartime development of the gas turbine—hampered at first by the intensive effort devoted to attaining technical superiority with the piston engine—eventually proceeded apace. But the intensive work and rapid strides that were made during the forties were perforce glossed over by Mr. Owner. The subject is vast, and lecture time not unlimited; his audience had to be content with a reference to the "unparalleled" effort that Whittle devoted to improving the efficiency of the neglected combustion chamber. Present-day efficiencies, Mr. Owner assured his listeners with a not-too-deceptive earnestness, were often calculated to be 102 per cent.

Reproduced on this page (Fig. 1) is the table that the lecturer used to sum up the many forms of aircraft propulsion systems. The major division of systems into those which are air-swallowing and those which carry their own oxidant have been intermingled and exchanged to form composite (separate propulsion systems) or compound (integrated system) aircraft propulsion units. The eight final systems are those which are most suitable for transonic or supersonic flight in different Mach number regimes.

Discussing some of the systems shown in the diagram, the speaker mentioned that propulsive ducts—which in aircraft require air launching or assisted take-off devices—have been under development in France since 1925. Rockets were chiefly exploited by the Germans, who used them in their He 176 and Me 163 intercepters. The development of practical rocket-propulsion aircraft caused some headaches, he recalled: the managing director was ordered to act as test pilot on the second Me 163

Fig. 1. Classification of aircraft propulsion systems.



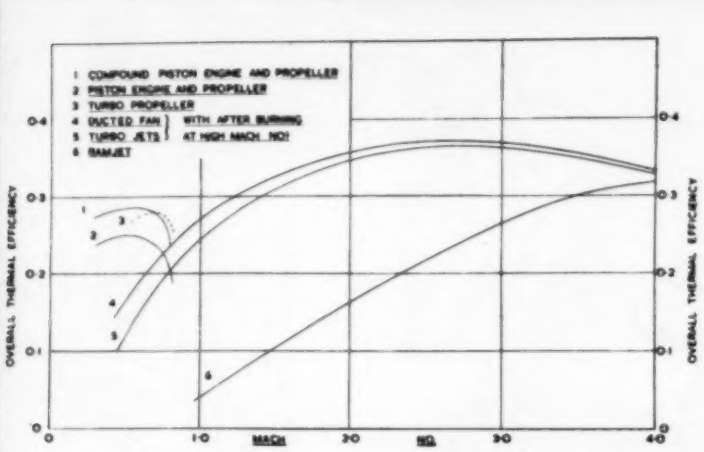

1 COMPOUND PISTON ENGINE AND PROPELLER
2 PISTON ENGINE AND PROPELLER
3 TURBO PROPELLER
4 DUCTED FAN } WITH AFTER BURNING
5 TURBO JETS } AT HIGH MACH NO!
6 RAMJET
OVERALL THERMAL EFFICIENCY
MACH NO.

Fig. 3. Overall thermal efficiency of powerplants at 40,000ft.

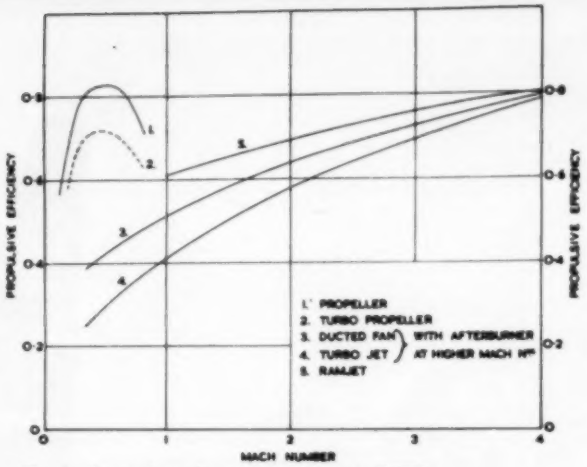


Fig. 4. Comparison of propulsive effect at 40,000ft.

after the first had crashed. A precedent, Mr. Owner suggested, that might cause a furore today.

The pulse duct, the speaker thought, might possibly have a helicopter application, although he doubted that the noise level would ever be acceptable. It was limited to operation at Mach numbers of less than 0.8, and was in any case not very satisfactory above $M = 0.6$.

A much more hopeful future was predicted for the ramjet/rocket combination; here the scheme was to use the rocket to induce a flow through the ramjet or to assist in flame stabilization. A diagrammatic drawing of the ducted rocket—unrealistic in that a convergent-divergent nozzle would almost certainly be used—is shown in Fig. 2. Rockets of this type are under development. In fairly short duration engines, various combinations of rocket and air-swallowing engines appear particularly attractive for high speeds and high altitudes. A gas turbine rocket propellant engine, for example, could burn large quantities of fuel injected downstream of the turbine into the oxygen in the turbine exhaust and the by-pass air induced by the compressor. [Other advantages may accrue from the use of unconventional fuels that might be too corrosive or too hot for combustion upstream of the turbine.]

"Where are these developments leading to?" asked the lecturer. With gas turbines, definite conclusions could be reached. Illustrating his remarks with "carpet" plots of specific consumption against specific thrust related to design pressure ratio and top temperature, he was able to show that definite trends occur with increasing Mach number. Below $M = 0.95$, it has long been established that a high compression ratio was required for economy and that high specific thrusts demanded high temperatures. But at $M = 2.5$, the consumption curves flatten out and even reverse their trend, and the high-temperature turbine engine gives a much greater thrust for very little increase in specific fuel consumption. High compression ratios are no longer desirable. At $M = 2.5$ the air leaving the compressor would be very hot—"almost red-hot" was Mr. Owner's term—and the specific output is reduced as a result.

The requirements for supersonic gas-turbine engines, he concluded, were the ability to make use of higher temperatures by using cooled blades—envisaged by Sir Charles Parsons 60 years ago—and the use of moderate compression ratios without sacrificing economy.

Next the lecturer turned to a consideration of the relative thermal and propulsive efficiencies of various types of motive power. His conclusions—which are based on Figures 3 and 4—were that, subsonically, from the viewpoint of thermal efficiency the turboprop was the most efficient engine; the ramjet had a high propulsive efficiency at transonic speeds, but the turbojet and ducted fan only really came into their own as the speed increased. The ducted-fan engine has a greater frontal area for the same thrust as the turbojet; or, in other words, there will be less thrust from the ducted engine for the same mass flow. For the same weight and same diameter, the pure jet and the ducted fan engine show little difference in fuel consumption, but subsonically or transonically the pure jet runs 200 deg cooler. "I have yet," added Mr. Owner, "to be persuaded that this is a disadvantage."

The most fascinating problem of all, decided the speaker, was the examination of combinations of rockets and ramjets with other engines. Should units be combined, hybrid or mixed? Ramjets must have a combination engine because of their low-speed deficiency, and piston/turbojets, turbojet/rocket and ramjet/rockets had all been investigated in recent years.

"If we can only exercise some of the extraordinary foresight of 100 years ago," Mr. Owner concluded, "we shall not fail in our new aircraft designs as Sir George Cayley did by lack of a suitable powerplant."

THE DISCUSSION

The discussion which followed the lecture was notable for the lively sense of fun possessed by the Brough branch of the Society, and for the penetrating questions that were posed.

Mr. Mathieson, the chief designer of Blackburn and General Aircraft, queried the use of atomic power in aircraft.

Mr. Owner's reply was that "I think we may be faced with the curious difficulty that they will be applicable to slower aircraft. Propeller-turbine aircraft would require 1,000 deg C atomic piles," he said, "and we do not know enough about the properties of materials at these temperatures while under radiation from reactors. So we will progress from the subsonic field."

Mr. Laight had two questions to ask. "What did the speaker think of the v.t.o. powerplant?" and "Should the engine and airframe be considered as separate parts or are we now in a position to think of an integrated flying device?"

Answering the second question first, Mr. Owner considered that more attention should be given to this concept; the airflow over the entire machine should be controlled—with "blowing" and boundary layer suction—by the gas turbine. This was probably the best answer to the problems of v.t.o. Given sufficient airflow control, take-off and landing would occupy very short distances. True v.t.o. would result in very high consumption from gas-turbine engines, and the problem was probably more severe from the point of view of a.t.c. than it was technically.

Replying to a final question on noise, posed by Mr. Hibberd, the lecturer said that to provide power without noise is demonstrably possible. When a Proteus is put on to the Froude brake the noise is terrible—from the brake. Jet splitting was probably "totally inadequate" in reducing noise, but he was "disgusted to hear" a suggestion that "the only solution is punctured eardrums in infancy."

TWO FROM THE BOOK-LIST

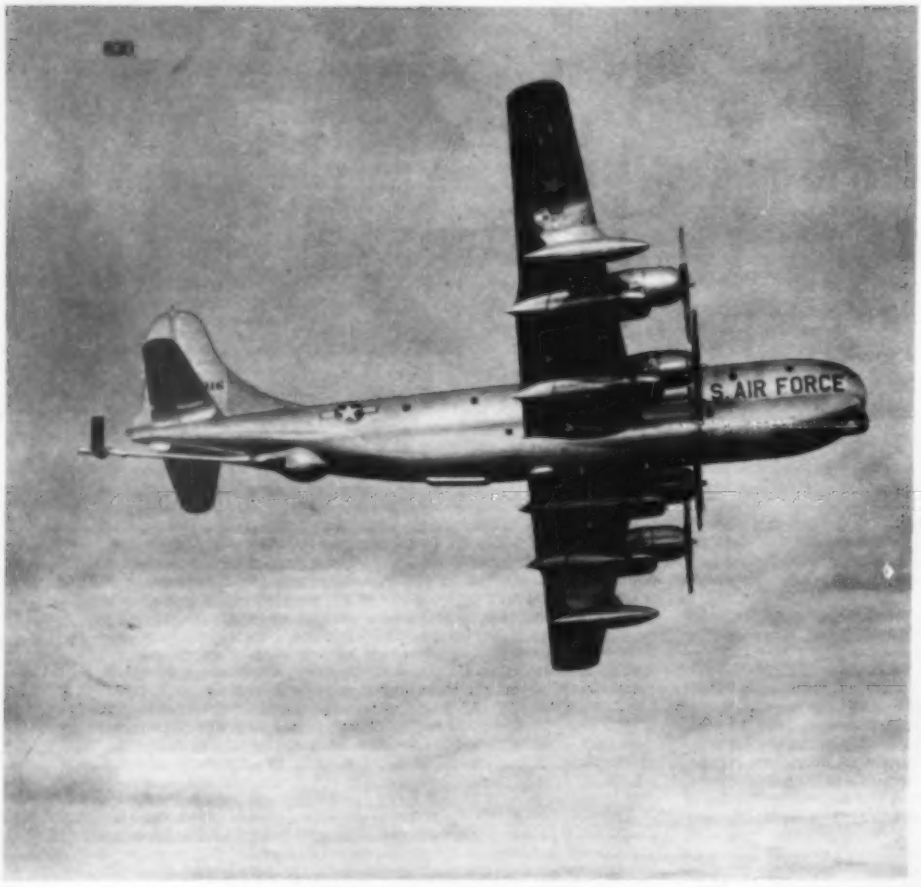
"Great Moments in Flying," by John W. R. Taylor. Illustrated by H. A. Johns. Phoenix House, Ltd., 38 William IV Street, Charing Cross, London, W.C.2. Price 7s 6d.

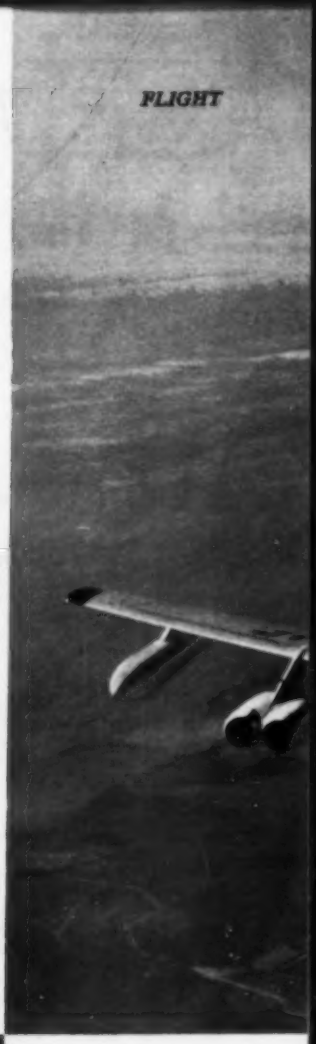
ANY father, uncle or god-parent who is puzzled about what to buy an air-minded youngster for a Christmas gift may well find the answer here. The author has re-told a dozen of the greatest stories in aviation history, from that first flight by the Wright brothers at Kitty Hawk to Col. Yeager's pioneer supersonic flight, from Alcock and Brown in their plodding transatlantic Vickers Vimy to F/L. Stainforth's brilliant 407.5 m.p.h. in the Supermarine S.6B on September 29, 1931—a record which stood for fourteen years. These stories, describing the greatest of many great achievements in aviation's unparalleled half-century, are told in a plain and crisp style. They should prove both instructive and inspiring.

"Scientific Wonders of the Atomic Age." Foreword by Sir John D. Cockroft. MacDonald and Co. (Publishers), Ltd., 16 Maddox Street, London, W.1. Illustrated. Price 15s.

FACING page 89 of this picture-book of the atomic age, in the middle of its section on astronomy, is a diagrammatic sketch showing how the film *Animal Farm* was made. This is curious, since page 89 itself is part of a description of the birth and death of a star; but the strange juxtaposition at least indicates remarkable comprehensiveness. The three chapters on aviation, one dealing with atomic age aircraft (by John W. R. Taylor), another with high-speed flight (by S/L. Neville Duke), and the third with "New Shapes in the Sky" (by David Keith-Lucas), are particularly well done.

Some readers may find some of the book's technical explanations over-simplified, but it is clearly aimed at the younger generation.





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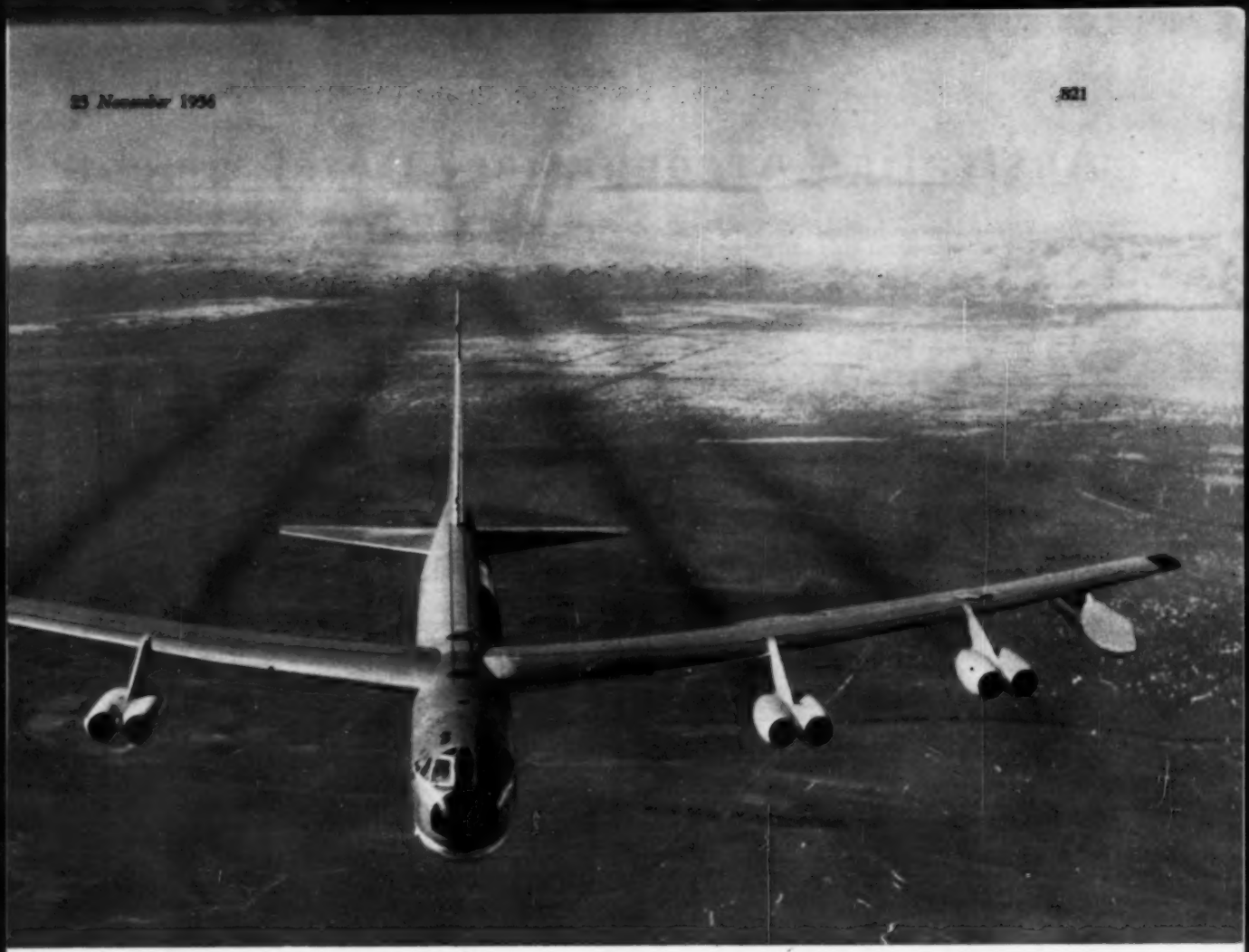

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TO do everything in a big way is the technical and business philosophy of the Boeing Airplane Company. Boeing are used to taking in their stride such programmes as the building of 888 C-97 Stratofreighters, the last example of which—a recently delivered KC-97 tanker/transport—is seen at upper left; and fifty-odd civil Stratocruisers have been giving exemplary service for several years. Now, with the last of the C-97s out of the shops, the company is moving into top gear on an all-jet programme. On the military side this centres on the KC-135—the C-97's successor, depicted in prototype form at lower left—and on the B-52 Stratofortress eight-jet heavy bomber. A B-52C presents itself above. Boeing's own production of the B-47 Stratojet (one is seen stabled with a KC-97 in the fourth picture) is now concluded; but with firm orders for 134 Model 707 civil transports on the books things are still "going great" for this big-thinking, big-doing, American company.

Australian Aeronautical Development

The Royal Aeronautical Society's British Commonwealth and Empire Lecture—Part I

A COMPREHENSIVE review of the field of aeronautics in Australia was given by Mr. L. P. Coombes, D.F.C., B.Sc., F.I.A.S., F.C.G.I., F.R.Ae.S., chief superintendent, Aeronautical Research Laboratories, Melbourne, in the British Commonwealth and Empire lecture which he presented before the Royal Aeronautical Society in London on November 22nd. Mr. Coombes is president of the Australian Division of the Society.

In considering the scope of the lecture [Mr. Coombes began], I felt that there were two main aspects; firstly, the development of aeronautics in Australia itself; and secondly, the value or possible future value, of this to the whole British Commonwealth. This train of thought had its beginnings ten years ago at a Commonwealth Aeronautical Research Conference in London. Sir Ben Lockspeiser, addressing the Conference, asked the Dominion representatives for a waterfall and a desert. These picturesque terms represented a genuine desire on the part of the United Kingdom to establish large scale communal testing facilities for the British Commonwealth of Nations. The waterfall was to supply power for a large supersonic tunnel, requiring up to half-a-million horse power for its operation. The desert was a large uninhabited tract of country in which experiments on supersonic aircraft and missiles could be made in good climatic conditions and without danger to innocent third parties. The supersonic tunnel proposal came to naught but, as you all known, the Rocket Range at Woomera in Central Australia is an accomplished fact, and is already the finest testing ground of its kind in the world.

It is not at all convenient for the United Kingdom to use a range 12,000 miles away, but the advantages of climate and topography and of drawing upon local resources of scientific and technical manpower are so great that the decision to establish this joint project was pursued with vigour. This is an example which might well be extended into other spheres of aeronautics.

The salient characteristic of the country is that all the natural features encourage air operations; in fact, certain areas like New Guinea are being developed entirely by air transport. Thus, Australia is particularly suitable for the intensive flying of aircraft. In addition, we find efficient and experienced operators, a modern aircraft industry for maintenance or modification, and research laboratories for consultation and laboratory investigations. Many United Kingdom firms now have branches in the country. Thus, Australia could well become the testing ground of the British Commonwealth for aircraft, as she has for guided weapons. She is a strongly pro-British member of the Commonwealth and has a great desire to strengthen it by helping to keep British aircraft in the forefront of progress.

I believe that Australia can play a much greater part in the aeronautical progress of the whole British Commonwealth if her natural advantages and resources are more widely known and utilized. I hope that my lecture will serve to inform other members of the Commonwealth of her achievements and potentialities in aeronautics.

Civil Aviation.—The greatest development in aviation in Australia has occurred in the civil transport field. It is unnecessary for me to give any historical introduction, because that was done most ably by Sir Hudson Fysh in the First British Commonwealth Empire Lecture of 1946. . . .

A feature of civil air transport in Australia has been the extraordinarily high utilization of aircraft. The table [right—Ed.] shows examples of the hours flown by various aircraft types in current use. In each case the figures are the mean for the whole fleet and can be regarded as typical.

The large passenger aircraft have utilizations of between 2,000 and 4,000 hours per annum, continued for periods of 10 years or more, the average being about 3,000 hours per annum. Small passenger aircraft which operate on feeder lines, and freighters, have lower utilizations. This is not a reflection on the serviceability of the particular types but of the kind of service on which they are engaged. Total lives, too, are becoming great and some of the DC-3 aircraft, which have seen the longest service of any type in use, are approaching a life of 50,000 hours. Loads, too, are very satisfactory. The overall load factor for all airlines is 63 per cent, while the highest load factor, 71 per cent, has been obtained on the Viscount fleet.

One result of this intensive utilization is that Australia is a good testing ground for civil aircraft. A second result is that the civil operators in Australia have encountered the phenomenon of structural fatigue earlier than has been the case in other countries; the particular aircraft types have often first reached the dangerous age in Australia, and this experience has been dearly bought. This fact was recognised many years ago and intensive research put in hand.

The growth of air transport and the high utilization of aircraft in Australia are due to a combination of a number of causes. First, we have the energy and enterprise of the operators. I am sure that Sir Hudson Fysh's lecture gave an adequate impression of this. A second major factor is the favourable climate, topography and distribution of centres of population. Our large cities are distributed on a roughly peripheral pattern. In other countries, such as the United Kingdom, the pattern tends to be radial from the centre of operations. The peripheral pattern allows aircraft to fly from stage to stage around the perimeter during the hours in which passengers are prepared to travel, and the aircraft stops at the last one reached for the nightly overhaul. It does not necessarily have to return to a central base. In the radial pattern, increases in speed of aircraft cannot be efficiently utilized unless the aircraft can make a complete extra return journey.

Another factor in the efficiency of Australian airlines is the unrestricted competition which is allowed and, indeed, cannot be prevented on inter-State routes under the Constitution. This forces operators to be bold and progressive in the choice of equipment and to buy from the country producing the best types. There does not seem to be the same degree of competition in other parts of the world.

The low fares charged by Australian airlines are a result of this free competition. Apart from competition between airlines, the railways carry passengers at fantastically low fares which are quite uneconomic and far below rail fares in other countries. One limitation on this particular form of competition is that the number of passenger seats available on trains and inter-State buses does not meet the demand. Between Melbourne and Sydney we find the following number of passenger seats available in each direction per week:—

Rail—1st and 2nd class	2,923
Road	980
Air	6,864

This particular run is the busiest, and the figures between other capital cities would not show such a striking comparison. On the long run to Perth there would be more rail passengers than air, but to Tasmania, where the boat service is extremely poor, the air services carry the great bulk of the passengers . . .

Air Freight.—Air freight in Australia is quite a large business. The actual ton-miles of air freight carried within Australian territories during 1955 was 53,180,000, which makes Australia the third greatest air freight carrier in the world. On a *per capita* basis, she ranks first. Despite this, there are two different schools of thought on air freight. On the one hand, the conservative operator argues that with present designs of freighter, direct operating costs are 1s (Australian) per ton-mile. Allowing for overheads, and the fact that backloadings are generally light, the cost of air freight is about 3s per ton-mile, which is the average rate charged. These operators therefore make air freight secondary cargo which fills in the loads on the passenger services. The advocates of air freight, chief among whom is Mr. I. Grabowski, development manager of Australian National Airways, do not dispute this

UTILIZATION OF CIVIL AIRCRAFT IN AUSTRALIA

Aircraft type	No. of a/c on which figs. based	Av. years in service	Average hours flown	Average utilization (hours per annum)	Greatest average utilization (hours per annum*)	Max. hours flown by any a/c
DC-3	36	14	27,800	2,005	2,850 for 11 yr	47,100
DC-4	16	11	29,050	2,640	3,615 for 10 yr	36,200
Bristol Freighter ...	3	10	12,650	1,270	1,350 for 10 yr	13,500
DC-6	2	9	23,600	2,630	2,680 for 9 yr	24,000
DC-4B	2	<2		3,440†		
Convair 240 ...	5	9	18,200	2,140	2,230 for 9 yr	20,100
340 ...	2	2		3,315†		
Viscount	5	<2		2,940†		3,280
Constellation ...	7	<2		2,505†		4,030
Dove	5	8½	10,400	1,210	2,040 for 9 yr	18,400

* Figures refer to the aircraft with the highest average utilization during its whole life.

† In these cases the type has only recently been introduced and the mean utilization for the whole fleet during 1955 has been given.

WESTLAND

The Westland range . . . Left: Dragonfly — Flying (left) Whirlwind Hovering (right) Widgeon and (foreground) new Westland Wessex

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The handling qualities, due in part to its three-bladed fully articulated rotor, are just those found in the larger types of helicopter. It is not difficult to fly, and the manoeuvrability is exceptional.

The throttle may readily be disconnected from the collective pitch lever, permitting practice autorotative landings without stopping the engine, and the engine may safely be left running on the ground.

The engine of 'One Hour Power' rating gives consistent and undiminished performance.

All maintenance can be done from ground level, except for the main rotor hub which is reached by using footholds on the helicopter structure.

Vision from the cockpit is unusually good, with a wide aspect rearwards.

A manual control of the centrifugal clutch prevents overloading of the rotor system when starting.

These are some of the features of the Skeeter helicopter which commend it for its chosen duties. Each of them contributes towards the economy which is a feature of its initial and operating costs.

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AUSTRALIAN AERONAUTICAL DEVELOPMENT . .

reasoning, although they believe that larger and more efficient freighters would reduce the direct operating costs. This in turn would put up average loadings so that overall ton-mile costs might even be halved. However, their main contention is that direct operating costs are misleading in making comparisons between surface and air transport and that factors such as speed of delivery, cost of handling, packaging against damage or dust, heavy vibration on bad roads, and many others, favour air transport even when there is an existing and adequate rail or road system. Aeroplanes show to advantage when surface transport is poor. Between the Australian mainland and Tasmania and the smaller islands, air freight is extensively used. Thus, 200 cars per month were being air freighted to Tasmania, and the ratio of farm animals being sent by air and by sea is approximately ten to one. Density of cargo is also a factor in ships, as freights are charged by the cubic ton and not by weight.

Air freight can play an important part in the development of outback country. In the more highly developed parts, roads and railways exist and their initial cost has already been met. If new country is to be opened, an all-weather road costs £15,000 per mile and a railway far more. Until the volume of traffic on such highways is large, the real total cost per ton-mile by surface transport is great. This fact is often concealed by not charging economic fees for the use of the permanent way. On the other hand, air transport initially makes light demands. Landing grounds for feeder-line or freight work are cheap and the capital charges per route mile are therefore quite small. Primary produce cannot pay charges of 3s per ton-mile, but a subsidy to halve this is a small price in comparison with building roads or railways. Moreover, if the venture is not a success, it can be stopped without wasting enormous capital sums . . .

Agricultural and other Civil Flying Operations.—There are other ways besides transport in which the aeroplane has been used to develop Australia. The Flying Doctor Service has been widely publicised and aeroplanes have been used to make mineral surveys; in particular to seek uranium.

Helicopters are only just being brought into use but already many applications for which they alone are suitable have been found.

Greater progress would be made in agricultural flying by the availability of suitable aircraft at the right price. In New Zealand, aerial top-dressing is the only method of bringing mountain areas into use, but in Australia the flatter terrain makes surface transport methods comparable or lower in cost. Nevertheless, the use of the aeroplane in agriculture is increasing. In the better rainfall areas top-dressing with super-phosphate alone, or with seeding, enables pastures to be developed quickly, particularly where the use of ground machinery is difficult owing to the steepness of the terrain, or because of surface obstructions such as rocks or fallen timber. This applies to areas of New South Wales, Victoria and Tasmania which total about 5 million acres . . .

The hours flown on agricultural work have increased rapidly over the past three years, the actual figures being:—

1953	5,000 hours
1954	10,600 hours
1955	20,900 hours

However, this increasing use of aeroplanes is mainly due to the convenience and speed and not to the economy of the operations. Any recession in prices of farm produce might force a large reversion to conventional ground methods.

After referring to private flying and the development of the flying and gliding clubs in Australia, the lecturer described the history of the Australian aircraft industry. After describing the current activities of the two major organizations, Commonwealth Aircraft Corporation and the Government Aircraft Factories, Mr. Coombes continued:

The Government Aircraft Factories have only recently entered the design field with the Jindivik, a high performance pilotless target aircraft, designed by Mr. I. B. Fleming, for use on the Woomera Rocket Range. Clearly, this beginning may well lead to further developments in the field of controlled unmanned aerial vehicles.

The only other current design efforts are private ventures by small firms. The most ambitious is a five-place tandem-rotor helicopter designed by G. C. Molyneux, a consulting engineer of Melbourne. A two-seater prototype is being built after extensive wind tunnel testing. The second venture is the P.L.7 Tanker, an agricultural aeroplane built by Kingsford Smith Aviation Service Ltd., of Sydney.

The third venture is a four-place cabin high-wing monoplane with a tricycle undercarriage and Gipsy Major engine, built by Fawcett Aviation Services, also of Sydney.

Unfortunately, this sound foundation of the art of aeroplane design appears to be doomed to crumble away. Aeroplanes of all but the simplest types, such as trainers and light aeroplanes, are becoming so complex and costly that only large and wealthy countries can afford to undertake new designs. Australia cannot compete in the military and larger civil categories and her very limited home market makes even the smaller types of aircraft a chancy commercial gamble.

These factors tend to limit the industry to the production of proven overseas military types; civil aircraft are needed in such small numbers that the cost of locally produced units would be prohibitive. One must, therefore, examine the needs of the Royal Australian Air Force.

The R.A.A.F. needs five types of aircraft: fighter, bomber, transport, coastal reconnaissance and trainer. At present the types in use are Avon-Sabre, Canberra, DC-3 or Bristol Freighter, Neptune and Vampire. The light bomber is not very suitable for implementing a policy of fighting a war away from Australian territory, and it is likely that something heavier and with a long range—in other words, verging on the strategic bomber—will take its place.

The question arises as to whether aircraft should be built in the country or imported. To this there is no simple answer; in fact, the issues are so complex and conflicting that the decision becomes a matter of policy. The economics are largely bound up with the numbers required. If orders are limited to 100 or less, two factors increase the cost per unit quite significantly. The first is tooling, which is generally a major initial expense. The difference between an order of 50 and an order of 500 could mean the difference between tooling costs of 30 per cent and 5 per cent of the production cost per unit. The second factor is the so-called "80 per cent learning curve," which has been proved in practice. This results in the following variation in unit and average cost (basic cost 100).

No. Ordered ...	1	10	100	500	1,000
Unit Cost	100	33	15	9	6
Average Cost ...	100	48	23	13	11

It is clear that other things being equal, a country which builds 100 aeroplanes will do so at twice the cost at which she can purchase them from a country which has the same aeroplane in large production. In spite of this fact, it has been estimated that Australia can compete with the U.S.A. because of wage differentials, but not with the United Kingdom, where labour costs are lower.

Several factors must be weighed against the higher cost of local production. First is the technical support which the constructing company can give the Air Force. In peacetime, it is impossible for a small Air Force to hold an adequate complement of technical personnel to cope with the operational problems of complex modern aircraft. The Service must lean heavily on the manufacturers and it is not very satisfactory if they are many thousands of miles away. Again, the Air Force must strive to keep its aircraft at the zenith of performance and this can only be done by incorporating the latest modifications as soon as possible. This is much easier with a local production, which also makes possible modifications to suit local conditions. Finally, repairs and spare parts are more readily available from the local manufacturer and, in time of war, this has proved a significant advantage.

In spite of these advantages, the Australian aircraft industry is likely to change over to an increasing extent to maintenance and the manufacture of spare parts. Even now, quite large concerns are growing up in this field.

I, myself, deplore the trend of events as I feel that it is not in the best interests of the British Commonwealth as a whole, nor even of the western democracies, to have the only major outpost and rallying point in the Pacific area almost completely dependent for the supply of aircraft on distant nations, who may be heavily involved themselves. Australia has production resources with trained and talented technical man-power, and it appears that these resources may disappear for want of nourishment. It may be argued that guided missiles will ultimately displace aircraft. In the U.K. it is the aircraft firms which are undertaking the manufacture of these weapons as they have suitable equipment and staff. The small size and large numbers required would suit the Australian industry admirably and, whereas aircraft can be flown in from other countries, guided missiles must be transported and local manufacture has considerable advantages. Thus, it is important that the Australian aircraft industry be preserved in the difficult interim period.

(*To be concluded*)

DECCA FOR R.A.F. HELICOPTERS

ROYAL AIR FORCE search-and-rescue helicopters operating in Europe are to be fitted with the Decca Navigator, states an Air Ministry announcement. This decision will call for the installation of Mk 8 receivers and Flight Logs in all Whirlwinds and Sycamores used by the R.A.F. for rescue duties in the United Kingdom and by 2nd T.A.F. for similar duties on the Continent.

The Decca Navigator system, already being used in an increasing number of R.A.F. fixed-wing aircraft, is generally agreed to be a particularly useful aid for helicopters, especially in view of its excellent performance at low altitude. In America, New York Airways—the helicopter airline—has already adopted the system.

Tony LeVier, Lockheed's director of flying operations and F-104 test pilot, poses in partial pressure suit with a prototype F-104. Production machines have forward-retracting nosewheel, intake shock-bullets, landing and taxying lights, and many other refinements. Span is 21ft 11in, length 54ft 9in and height 13ft 6in.

Some Operating Characteristics of the F-104A Revealed

"GET WITH THE STARFIGHTER"

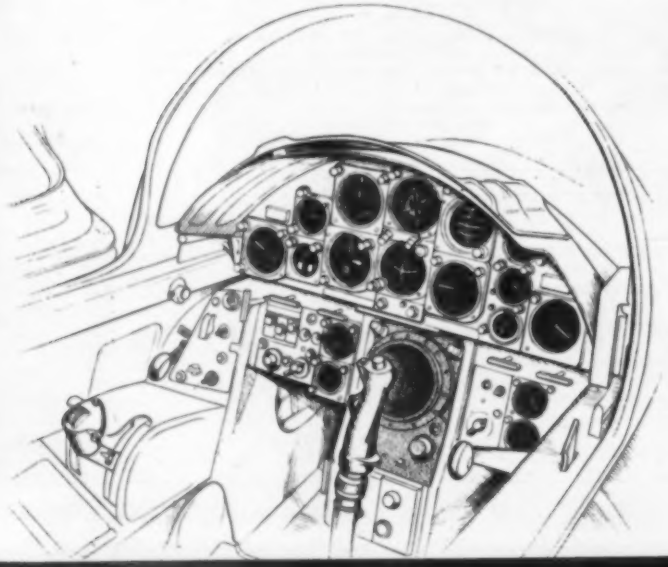
WHEN people had regained their breath after the unveiling (two years after its first flight) of the U.S.A.F.'s "hottest shape," the Lockheed F-104 Starfighter, rumours began to spread. The aircraft had limited capability. It was too small to carry the equipment necessary for an all-weather interception or tactical strike role. Endurance and range were too restricted. The internal armament of the unorthodox B.1 "Gatling" gun was light in weight, but not suited to air combat because of its extremely short firing time.

All this Lockheeds vigorously deny and continue to claim that the Starfighter is the world's fastest combat aircraft—which indeed it is.

Little official information on the Starfighter has been released even now (though a detailed analysis of the aircraft by the Technical Editor appeared in *Flight* on April 20). The more remarkable, therefore, is a feature article in the November issue of *Flying Safety*, an official U.S.A.F. publication. It is written by Tony LeVier, Lockheed's director of flying operations and test pilot responsible for the F-104's first and many subsequent flights. Couched in real U.S.A.F. pilots' language, it gives some intriguing "poop" on the aircraft and goes to some lengths to point out that "pilot transition" will be "no sweat." "The F-104," LeVier says, "is a bird in which the pilot can really get with it."

About the cockpit he says "everything is compact, built snugly around you . . . the pilot is properly placed, visibility is excellent and everything is real handy." Desired cockpit temperature can be set on a single dial and then disregarded. Fuel-system management is like that of a car, unless external fuel is being carried; then a single switch has to be thrown.

A major consideration in the design stage was to achieve simplicity in the interests of safety; and electronic equipment was included (from the start of the design) to make the machine behave naturally. A Lear three-axis, transistorized stability augmentation unit, weighing 18 lb complete, senses and corrects movements of "a tiny fraction of a second" to prevent gusts and turbulence from upsetting stability. "The F-104's fineness of control is the finest."



Despite its extremely high altitude and speed capabilities, the F-104 is quite straightforward in the circuit, according to LeVier. It touches down at 135 to 150 kt, depending on weight, and the circuit speed is 200 kt—just about the same as for other century-series fighters. The addition of leading-edge flaps has provided ample deceleration for approaches and the aircraft can comfortably use 6,000-7,000ft runways. Such a favourable combination of high- and low-speed performance was achieved to a great extent by keeping the gross weight down. Yet the small, thin wing is stressed to take dynamic loadings of over a ton per square foot. The airbrake housing, for example, had to be strong to support the air loads on surface extension; but the strength of the fitting was used to provide in addition an engine mounting point and a fuselage-break attachment. The strength of the housing itself was partly achieved by stressing the hydraulic actuating cylinder.

The pilot-ejection seat leaves the aircraft downwards through a large floor panel. This is claimed as a safer method of escape, since the ejection velocity need not be high enough to clear the fin at high speed. The low-level bale-out case is not discussed. As a result of this system, the canopy is a side-hinged structure, free of the weight and complication of actuating motors, rails and jettisoning devices. LeVier calls it a "do it yourself" canopy, because it is entirely manually operated.

There are two completely separate hydraulic systems, supplied by two engine-driven pumps. With the engine idling or windmilling, pump output is still sufficient for all normal needs. If the engine stops dead, a ram-air turbine driving a generator and hydraulic pump can be extended. Most of the hydraulic components are laid out like a diagram on a very large underfuselage panel which hinges down aft of the mainwheel bays.

During early testing, LeVier had a flame-out at altitude and glided 50 miles back to Muroc for a dead-stick landing. With the aircraft in clean condition the gliding performance is fair, glide ratio being ten to one. A remarkable advantage in this situation is that the forward-retracting undercarriage will extend and lock down under gravity in three to four seconds so that it can be lowered without hydraulics during the roundout of a dead-stick landing. This must considerably simplify emergency landings, apart from doing away with the need for an emergency lowering system. During a power-on approach, the throttle response is very fast and precise.

Col. "Chuck" Yeager was the first pilot outside Lockheed to fly the F-104 and he immediately enthused about its handling qualities. He himself told *Flight* that it had the best powered-control system he had ever known. Another U.S.A.F. test pilot, who specialized in control characteristics, also flew the aircraft. At about 45,000ft he nosed over into a dive and took his hands and feet off the controls. He reached a Mach number well above unity and only had to take the controls again in order to pull out when the ground was coming up. He is reported to have said it was "just like riding an elevator." Yeager had called it "a real tiger"—a compliment in American terminology.

Features of the F-104 cockpit include I.L.S. meter; combined logarithmic A.S.I./Machmeter; miniaturized turn-and-slip; clock; V.S.I. reading to 6,000ft/min; fire-control radar scope; and very large fuel gauge at right. Dials are individually lit and panel background colour is pale grey.

LONDON OFF-LIMITS

The Private Pilot's Dilemma—and Three Possible Solutions

THE private pilot is gradually being squeezed out of the London area by the combined (though not necessarily concerted or deliberate) actions of the Ministry of Transport and Civil Aviation, the aircraft manufacturers, and some local residents hostile to flying near their homes. This situation, foreseen for years, now becomes a critical one with the news that Croydon is soon to disappear. Like Noah's dove returning to the Ark after her first (unsuccessful) sortie, the humble user of a small aeroplane will soon find no rest for the sole of his foot on any airfield in the metropolis.

Just before the war, there were ten aerodromes available for private pilots within the London Control Zone. Two of them —Croydon and Heston—offered Customs facilities; all had refuelling services; and all except two could provide hangarage.

That happy position has considerably worsened now, although the number of airports and aerodromes within the L.C.Z. (which is itself larger) has increased to fourteen. For when the private pilot visiting London on business or for pleasure comes to look for somewhere in the Zone which can offer him refuelling, hangar and repair facilities, he finds that only four airfields fall into that category. These are Croydon, Elstree, Fair Oaks and White Waltham. But both Fair Oaks (near Woking) and White Waltham (near Maidenhead), are quite a long way out; and of the four, only Croydon can provide Customs for pilots entering or leaving the Continent.

What has happened to the others? Six are used by the industry, viz., Brooklands, Hatfield, Langley, Leavesden, Radlett and Woodley; though Hatfield, Leavesden, Radlett and Woodley are listed in the U.K. *Air Pilot* as open to civil pilots on prior permission.

Of the remaining four, Northolt has reverted to the R.A.F. and the other three offer no solution for the private pilot's dilemma. Denham is small, fairly well out and not very accessible except by car, and can offer no hangarage and only limited repairs. Hendon's future is at present in the balance; a suggestion about it is made later in this article.

The fourth is London Airport, which has certain melancholy implications for the private pilot. One of these is that its operations have nullified two airfields—Hanworth and Heston—which before the war were available to him. Both provided refuelling, hangarage and repairs, and Heston also had Customs. A second sad implication is that although in theory a private pilot may land at London Airport, in practice it is hedged about with so many restrictions he is rarely likely to be able to do so. Relevant regulations in the *Air Pilot* read: "All aircraft using airport are required to be equipped with I.L.S. unless special permission, which will be given in isolated instances only, is obtained from Commandant before the flight"; and "Use normally restricted to aircraft operating on scheduled services, but M.T.C.A. is prepared to consider individual applications from operators who are unable to use other aerodromes in the London area, or who have a special reason for wishing to use London Airport. Applications should be made to the Commandant during normal working hours and at other times to A.T.C. Except in special circumstances, at least 24 hours' notice should be given. Applications in respect of single-engined aircraft, or for flights for recreational purposes, will not normally be granted."

This virtually rules out the private pilot. Yet at some Continental and United States airports the story is quite different. Private aircraft are admitted to Schiphol, Amsterdam, provided they have two-way V.H.F. with correct frequencies; Urbe, only three miles out from Rome, is open to tourist traffic; Barajas, Madrid, has no restrictions. True, Paris Le Bourget and Orly are limited like London to scheduled and transport aircraft; so are Idlewild and La Guardia at New York. But at many American airfields military, commercial and private aircraft operate happily on the same site. This is possibly because in that country the private and business pilot is in a much stronger position—through various representative organizations—than he is here when it comes to bargaining or battling with the authorities.

The possibility of a private or executive pilot, British or foreign, being able to land and lodge his aircraft within convenient reach of London will be even slimmer when Croydon is closed. (Stapleford Tawney remains a possibility; though outside the Zone, it is within convenient reach.) This misfortune has been threatening him for years and, as things stand now, may come to pass by 1959; for a recent M.T.C.A. pronouncement said the airfield would be "closed and up for sale" by the spring of that year. This will please some of the local residents who have from time to time protested about private flying at Croydon. In September, 1954, *Flight* reported: "Increasing use of Croydon Airport by flying clubs has led a committee representing local residents to approach the Minister of Civil Aviation, asking him to take 'immediate steps' to control their activities. The residents allege that the small aircraft are 'both a nuisance and a potential danger.'" Perhaps these residents have strong reasons for their protests; but it is hard to see that the small aircraft are quite the nuisance they make them out to be. They do not make nearly as much noise as jets (although, of course, they fly lower); they do not often fly at night; and how is one to fly at all in this small country without flying over houses?

The residents at Croydon, however, look likely to win the day. For the M.T.C.A.—which presumably caters for the small flier as well as the big airlines—has decided that aircraft now operating at Croydon will in future do so from Gatwick, "Stage I" in the development of which is expected to be completed by the spring of 1958. This move to a base still further out of London chiefly affects the charter services and the companies with premises at Croydon. What about the private pilot who flies from there? He will be admitted to Gatwick provided —note the conditions—he is fully rated for I.F. and his aircraft carries suitable radio equipment. These conditions will also apply to executive aircraft, for which Gatwick is too far out from

On the right, a sketch-map showing present-day civil airfields (heavy dots) in the London Control Zone, which is indicated by the dotted line. These airfields are superimposed on those existing in 1939, all of which offered facilities for the private pilot.

Better or worse? The meagre selection of airfields (shown on left) around London available in 1927. But at least four of them were conveniently close to the town centre.

LONDON OFF-LIMITS...

One of the busiest airports in Canada, Toronto manages to accept both light and heavy aircraft with no fuss. London is a different story . . .
"Flight" photograph

London to be really convenient. But what about private pilots whose experience is insufficient for them to use Gatwick? They will be moved out of Croydon to some "suitable" alternative accommodation. But where is this to be found? Most alternative airfields are already full. It almost certainly means somewhere much farther out of London. There are three possible solutions which the M.T.C.A. can apply to the private pilot's dilemma, if it chooses to assist him in maintaining a metropolitan foothold. The first and simplest (and probably the best) is to allow private flying to continue at Croydon after the charter companies have moved away to Gatwick. The residents may still protest but the airfield was there long before they were, and traffic was even heavier pre-war. Moreover, it is impracticable to expect all private flying to be carried out from isolated country aerodromes.

If Croydon must be closed entirely and the private pilots pushed out, a second solution which could apply is for Gatwick to be made less restricted for them in all but I.F.R. conditions. It would be particularly useful for light aircraft visiting or returning from the Continent; they could use the grass strips and would not interfere with the heavier machines.

A third solution, and one which has steadily been attracting support, is for Hendon to become the private pilot's airport for London.

Since the Air Ministry announced, earlier this year, that R.A.F. flying was to cease at Hendon, the idea of using it for light aircraft has been strongly mooted. We understand that the Royal Aero Club has been asking the M.T.C.A. for the use of Hendon by private and executive aeroplanes; and certainly this famous airfield, with its great traditions, would be an ideal "private owners' airport" for London.

It is readily accessible from the city by road and rail; it is quite large enough for light aeroplanes (though it is not ideally suitable for elementary flying); and it could have Customs facilities for Continental trips.

In the House of Commons on November 5, the Air Minister said that Hendon's future was being examined and that he was in touch with the Minister of Transport and Civil Aviation about its usefulness for civil flying. It is much to be hoped that the latter decides in favour of allowing its use by the private pilot, who would at last have the feeling that he was no longer merely the Cinderella of aviation in the U.K.

H. W.

THE DELTAVIEX

THE tiny French jet-propelled aircraft illustrated last week on page 775 is now known to be called the Deltaviex. It was built, a correspondent reports, as a test-bed for numerous devices in which O.N.E.R.A., the French National Research Establishment, was particularly interested. The aircraft is not, in fact, a delta, but the wings have a 70-deg sweep. A Marboré turbojet of 880 lb thrust is installed, and it is reported that, because of the sharp wing sweep the machine is "sensitive on the controls and laterally unstable". Collector manifolds take air from the engine compressor and vent it through holes of 0.7 mm diameter at the flap trailing edge. The horizontal tailplane is variable in incidence and very sharply swept. Having flown for a number of hours piloted by Lucien Fouquet, the Deltaviex is shortly to be scrapped.

THRUXTON'S NEWCOMER

CURRENTLY under development at the Wiltshire School of Flying, Thruxton, is the Thruxton Jackaroo, a four-seater Tiger Moth conversion. The first flight of the prototype machine is scheduled for February 1957. An artist's impression of the Jackaroo mock-up appears on an earlier page.

The original idea for such a modification was put forward by S/L. J. E. Doran-Webb, managing director of the Wiltshire School of Flying, in August of this year. Provisional sketches were made the following month, and detailed stress calculations and design drawings were begun by Mr. R. Prizeman, D.C.Ae., a light-aircraft enthusiast whose racing-aircraft project was runner-up in the racer category of the 1953 Royal Aero Club design competition.

S/L. Doran-Webb expresses the philosophy behind the Jackaroo thus: "There is in this country and, indeed, abroad, a very good demand for a light four-seater aircraft; something in the nature of a station-wagon, an aircraft without frills, designed to transport four people or the equivalent amount of freight economically; and, moreover, an aircraft of low initial cost."

Thruxton's answer to this demand, the Jackaroo has as its main feature a widened section of the fuselage to accommodate a four-seat, enclosed cabin. An extended wing centre-section increases the span by 12½in to 30ft 4½in, and the undercarriage track is increased by 1ft to 6ft 3in. The "maximum target price" of the machine, with a nil-hour reconditioned engine, will be £990, while conversions of existing Tigers to Jackaroo layout should cost some £600 and take about ten days at Thruxton. For overseas operators, a packaged conversion kit is planned which would cost £530; the estimated conversion effort required is approximately 100 man-hours.

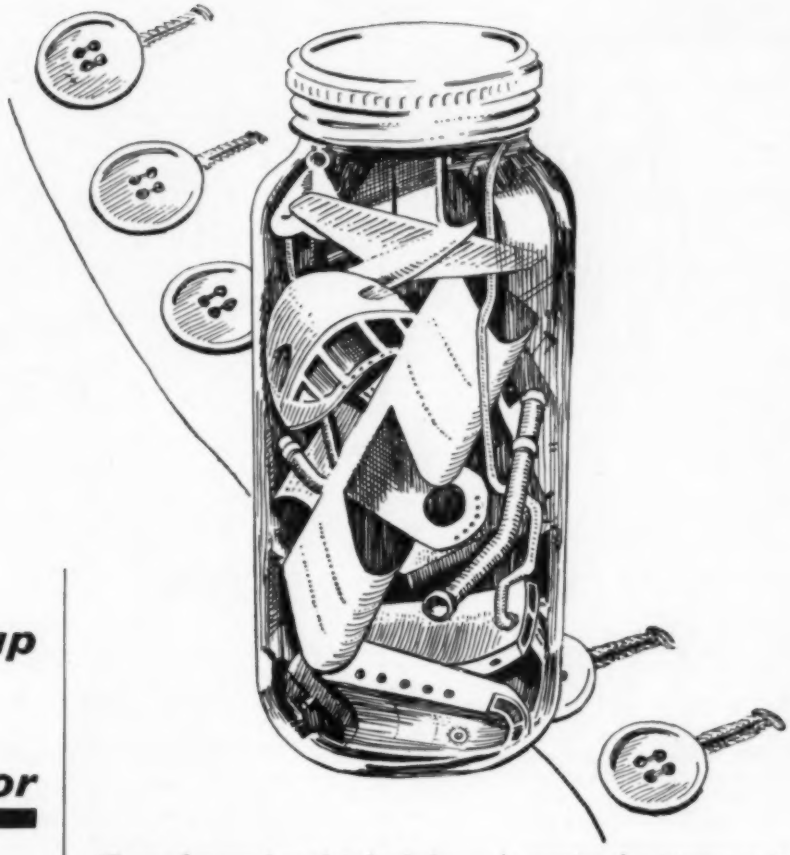
In addition to its use as a cheap, general-purpose four-seater with the flying clubs and private owners, the Jackaroo is envisaged as a light freighter and crop-dusting aircraft. The basic machine will carry pilot plus either three passengers or over 500 lb of freight. While it remains a melancholy reflection on this country's light-aircraft industry (or lack of it) that the four-seat conversion of a 25-year-old design is needed to provide a cheap all-purpose aircraft, Wiltshire's Jackaroo is a commendable example of enterprise by a club organization to meet a general club need—and to extend, in the process, the usefulness of the ubiquitous Tiger.

FORTHCOMING EVENTS

Nov. 23. R.Ae.S.: Graduates and Students Section: "Effects of Kinetic Heating on Aircraft Structures," by A. W. Kitchenside.
Nov. 26-27. I.A.S.-C.A.I.: Joint Meeting, Toronto.
Nov. 27. Photogrammetric Society: "Problems and Progress in Air Photography," by G. C. Brock.
Nov. 28. Kronfeld Club: "Test Flying," by A. W. Bedford.
Nov. 30. R.Ae.S.: Graduates and Students Section: Annual Dance.
Dec. 1. British Interplanetary Society: "Use of Probe Rockets," by C. A. Cross, M.A.
Dec. 3-8. Association Pour L'Encouragement à la Recherche Aeronautique: Exhibition of Rockets, Guided Missiles, and their Equipment, Paris.
Dec. 6. Institute of Refrigeration: "Cooling Problems in High Speed Military Aircraft," by Miss B. Shilling, O.B.E., M.Sc.
Dec. 7. R.Ae.S.: Graduates and Students Section: Film Show.
Dec. 7. Helicopter Association: "Automatic Pilots for Helicopters": Part I, "Theoretical Considerations," by H. Collomosse, B.Sc.; Part II, "Flight Development," by M. C. Curties, B.Sc., A.F.R.Ae.S.
Dec. 8. Society of Model Aeronautical Engineers: Annual Dinner and Dance.

R.Ae.S. Branch Fixtures

Nov. 26, *Henlow*, "Meteorology: Clear Air Turbulence," by Dr. R. S. Scorer. Nov. 27, *Boscombe Down*, "Aeroplane Noise: A Challenge," by Prof. E. J. Richards; *Belfast*, "Atomic Energy for Aircraft Propulsion," by Dr. Bauer. Nov. 29, *Isle of Wight*, "Recent Developments in Production Processes," by W. E. Goff. Dec. 3, *Derby*, "Development and Production of High Temperature Alloys for Turbine Engines," by H. E. Hignett; *Glasgow*, "Supersonic Aircraft and Missiles," by P. J. Duncton. Dec. 5, *Bristol*, "Prospects and Problems in British Aviation," by P. G. Masefield; *Luton*, "Trends in Aircraft Electrical Installations," by H. Zeffert; *Chester*, "Problems Associated with Non-metallic Materials in Aircraft," by N. J. L. Magson and E. W. Russell; *Christchurch*, "Transfer Machining," by A. J. Sephton. Dec. 10, *Henlow*, Student Members' Lectures. Dec. 12, *Leicester*, Annual General Meeting and Film Show; *Christchurch*, "American Production Methods," by J. A. Mackenzie; *Coventry*, Lectures by Junior Members; *Merthyr Tydfil*, Film Show; *Preston*, "Novel Methods of Take-Off and Landing," by T. J. Cummings; *Southampton*, Fourth Mitchell Memorial Lecture, "Noise and Aircraft Structures," by Prof. E. J. Richards.



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or

buttoned-up?

All manufacturers have their headaches — the question that interests us is whether they lie bottled-up or get buttoned-up.
Frankly, we are no good at the bottling-up business, but we are certainly old hands at buttoning-up a problem — in fact, for over fifty years now we have, quite literally, tackled a thousand and one different jobs, putting us in the position of being able to provide a technical service for aircraft manufacturers that is, we are proud to say, second to none.

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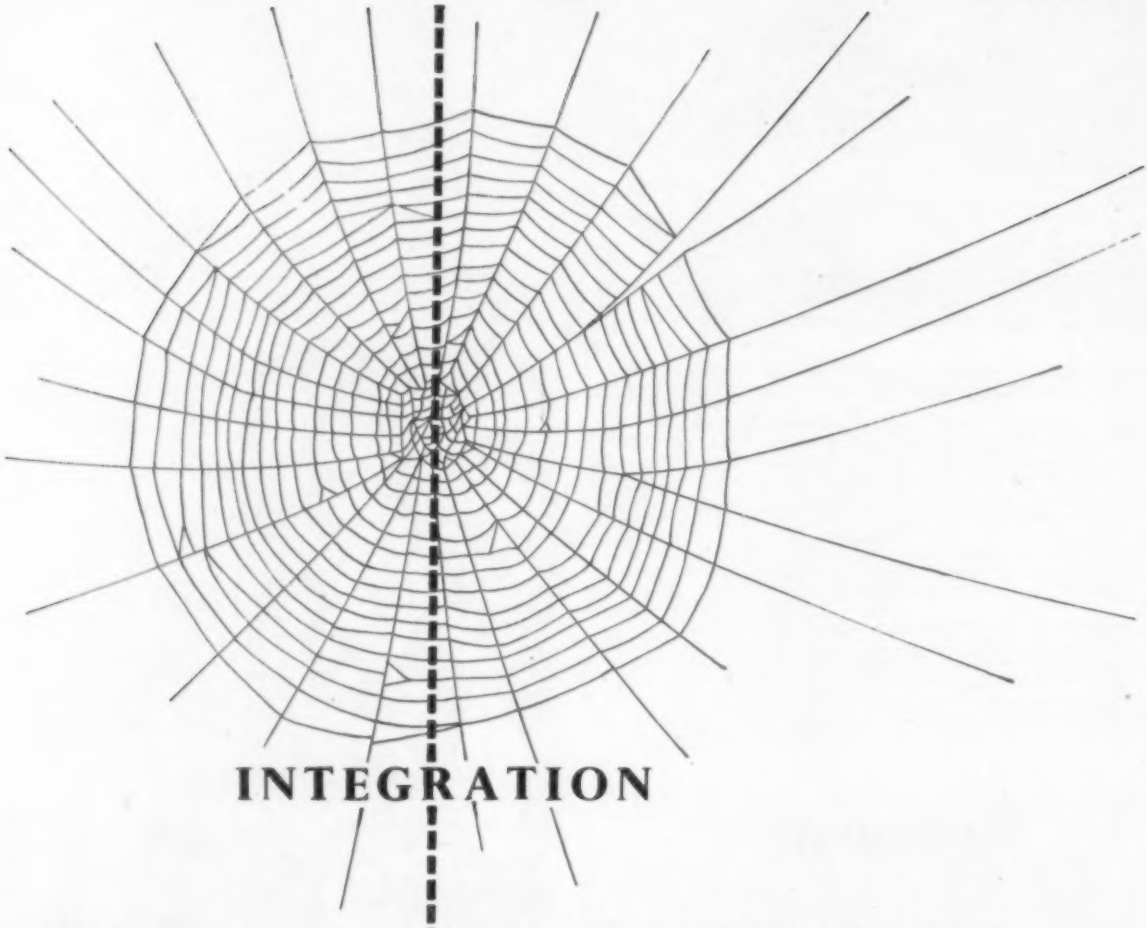

INTEGRATION

The Spider's Web consists of a system of threads radiating from a common centre and crossed at intervals by a series of concentric lines. Signals — recording the unusual or the routine — are instantly transmitted from any point of the spider's web to the centre and thence along the trap line to the spider, thus integrating information, saving time and effort.

The philosophy of integration was adapted by Sperry to improve aids to the pilot of modern aircraft and resolve the problems of human and mechanical engineering associated with high-speed flight. Sperry set the pattern with the introduction of the "Zero Reader" flight director in 1948 and now the unrivalled experience of Sperry in gyroscopic, electronic and hydraulic techniques has led to the further development of integrated instrument and control systems to facilitate the operation of modern high-performance military and civil aircraft.

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INFRA-RED POSSIBILITIES

Remarkable Feats of Detection: Dr. Jones' Radar Association Lecture

LAST week Dr. F. E. Jones, M.B.E., B.Sc., Ph.D., A.M.I.E.E., a director of Mullard, Ltd., read a paper—abstracted below—before the Radar Association entitled "Infra-red—its Problems and Possibilities." Although unable to say so directly, by reason of security, the author left very little doubt that the military possibilities of such wavelengths are enormous, particularly for the homing of guided missiles. Dr. Jones, who was deputy director of the R.A.E. before joining Mullard this year, was closely associated with the development of the "Oboe" blind-bombing system during the war.

THERE is a well known saying which goes "I shall not believe it until I see it with my own eyes." The eye is, of course, a very well designed receiver of electro-magnetic radiation working on a narrow band of wavelengths around 1/2000th of a millimetre, i.e., 0.5 microns (a micron is one-millionth of a metre). It sees each particular wavelength as a colour: for example, at 0.4 microns it sees violet and at 0.75 microns it sees red. Beyond 0.75 microns (where the eye ceases to respond) and up to 1,000 microns lies the infra-red. The region immediately beyond 1,000 microns, or 1 mm, is the radar spectrum; and although the lowest wavelength to be used for equipment work is 8 mm (high-resolution airfield radars) this is only because techniques are insufficiently developed on wavelengths below 8 mm.

The main advantage of short radar wavelength is that it gives high resolution with a small aerial size. The resolution of a radar system is proportional to D/λ where D is the diameter of the scanner and λ the wavelength. Thus on X band (wavelength 3 cm) a radar with a 1ft-diameter scanner can separate-out two aircraft at five miles' range and one mile apart. On a wavelength of 8 mm it could distinguish between them if they were a quarter-mile apart. In the infra-red, on a wavelength of 1/500th mm (2 microns) an infra-red receiver even with a 3in-diameter scanner could resolve the separate engines on a single aircraft at a range of five miles.

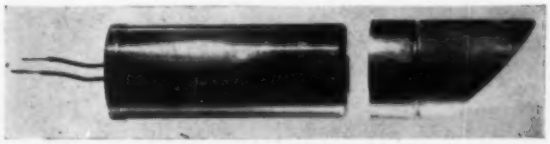
Transmission.—All warm bodies transmit infra-red radiation, the amount and wavelength depending on the temperature of the body and on its surface. The amount transmitted depends on the fourth power of the temperature, i.e. $P \propto T^4$. Thus a body at 1,000 deg K, say a jet engine, transmits more than 250 times as much power as a kettle of boiling water with a temperature of 373 deg K. In addition, the band of wavelengths transmitted is also a function of the temperature, the wavelength λ max on which maximum power is transmitted being given by the simple formula

$$\lambda \text{ max} = \frac{3{,}000}{T^\circ K} \text{ microns}$$

Thus we see that for the following bodies the λ max is as follows:—

Radiating Body	Temperature (°K)	λ max. in microns
Sun	6,000	0.5 (visible light)
Jet aircraft engine	1,000	3.0
Piston-engined aircraft	750	4.0
Kettle with boiling water	373	8.0
Human body	300	10.0

Theoretically, then, we have only to make a receiver to work on the various wavelengths and we can detect the body concerned—the hotter the body the easier the problem is, because the more power it transmits.



One of the latest Mullard photo-conductive cells, of the cooled lead-telluride type. This particular example is 36 mm in diameter.

Reception.—Broad-band receivers which receive all infra-red wavelengths equally well have been known for many years. These are the thermal detectors known as radiation thermocouples and bolometers. They rely for their action on the warming-up effect of the incoming radiation, and in general they are too sluggish in their response-time to detect rapidly moving objects.

The modern infra-red detector is one based on a German war-time development—photo-conductivity in the infra-red. In this type of detector a semi-conductor is employed—the same class of material as is used in transistors. A semi-conductor, as its name implies, is a material that in its electrical properties lies between a conductor and an insulator. In a photo-conductor infra-red detector the semi-conductor is in the form of a thin layer between the electrodes, across which a potential is supplied. The resistance of the layer is usually fairly high (in excess of 100,000 ohms) and when infra-red radiation is allowed to fall on it the resistance drops: this is in turn indicated by a fall in the applied potential.

A detector of this type does not require that the temperature of the layer shall change—the effect is caused by the *absorption* of radiation in the layer. Thus each unit of infra-red radiation absorbed releases an electron in the layer which would not normally have been free, and these freed electrons flow across the layer and add to the steady leak current caused by the applied voltage. The effect causes measurable changes in voltage for very small amounts of infra-red radiation, and, what is very important, the change takes place in a few micro-seconds. Thus even the Fairey Delta 2 will have moved only about two inches in the time that it takes a photo-conductor to respond!

These photo-conductor detectors work only over certain wavelength ranges, i.e. they are selective, and the particular semi-conductor material must be chosen to suit the required wavelength. The most common materials for the layers are lead sulphide, which responds to about 3 microns; lead telluride, to 4.5 microns; lead selenide, to 6; indium antimonide, to 7; and Germanium, which responds out to very long wavelengths—possibly 100 microns. All these materials must be specially treated to give them infra-red sensitivity, and all of them with the exception of lead sulphide (and possibly lead selenide) need to be kept cool, i.e., refrigerated, to make them sensitive.

In foggy or misty weather a safe assumption is that the transmission of infra-red radiation is exactly the same as that of visible light. This is because the diameter of fog particles—of the order of up to 80 microns—is still large compared with infra-red wavelengths. Thus infra-red is of no use in fog or cloud. Even in clear weather the atmosphere completely absorbs much of the radiation; for example, the only wavelengths reaching us from the sun lie in the bands visible to 2.2 microns (with two gaps), 3.4 to 4.0, and 8.5 to 13.5. The remaining bands are all completely absorbed by the water vapour and carbon dioxide in the atmosphere. At high altitudes the transmission-windows increase in width, because there is little water vapour above say 30,000ft, and a reduced amount of carbon dioxide. In general, however, if one wishes to detect a hot body the most appropriate of the three atmospheric windows must be chosen.

If we now consider some of the military applications of infra-red the most common are the well known night-driving, sniping and signalling systems in the near infra-red, that is, in the region beyond 0.75 microns, where the eye just fails to detect. As normal bodies transmit very little radiation in this region it is necessary to illuminate the object with a searchlight in the normal way, except that the visible-light emitter is cut off by a filter. The searchlight normally has a tungsten-filament lamp operating at about 3,000 deg K, and hence considerable power in the 0.75 micron region is transmitted, reflected by the object and detected.

The main disadvantage of such systems lies in the fact that the illuminating searchlight can be detected at very great ranges with a suitable infra-red detector, because the temperature of the lamp is very high.

As far as passive detection is concerned, the Germans first used a lead-sulphide detector, mounted in a 150cm-diameter searchlight mirror, in about 1942, to detect for allied night bombers. This equipment was known as the Elac NMG42. Later they tried experimentally an air-to-air detector system, rather along the lines of a passive A.I. [airborne interception], which gave the bearing, but not the range, of a target ahead of a fighter. This equipment, known as Kid, had a scanning mirror about four or five inches in diameter and could indicate accurately the bearing of a target ahead at several miles' range. Additionally the Germans had an equipment called Madrid which was in the form of a homing eye or infra-red seeker suitable for a guided missile. All these equipments used lead sulphide cells working in the 2 to 2.2 micron atmospheric window, as this was the only detector material the Germans could make sufficiently sensitive for infra-red detection.

Little if anything has been published about modern military applications of the range of detectors now available, but a modern lead-sulphide cell, for example, is at least 10 if not 100

(Concluded at foot of col. 2, page 830)

FROM THE CLUBS

The Lycoming Gemini conversion mentioned in the Australian news item on this page.

THE Wiltshire School of Flying, whose entry into the aircraft-design field with the Thruxton Jackaroo is reported elsewhere in this issue, report that they have carried out more C. of A. overhauls during the last three years than any other club or company in Britain—with the exception of B.O.A.C. Total flying time this year, up to the end of October, was 3,412 hours, logged on a fleet of five Austers, five Tiger Moths and four Proctors. During this period 28 pupils obtained P.P.Ls, and 60 qualified for A.B.A.C. wings. A club party is to be held on Saturday, December 1, at the club-house at Thruxton.

ALMOST 500 flying hours have been logged this year by members of the Experimental Flying Group at Croydon, the majority on Magister G-AITN. During the summer's operations, a group record of 13 hr 10 min flying by one aircraft in one day was set up. Under the supervision of engineer Peter Elliott, issue No. 1 of the new *Experimental Flying Group News* reports, a considerable amount of maintenance has been carried out on G-AITN by group members, including two engine-changes and a complete stripping and repainting of the fabric-covered tail surfaces, in addition to various checks 1 and 2 and general cleaning.

This year's first solos include those by Messrs. Patey, Burn, Trew, Gainsford, Bullock, White and Bowen, and by Miss Cole and Miss O'Kane; while Messrs. Patey, Bullock, Foster, Fenner and May and Miss O'Kane have obtained P.P.Ls. A flying camp near Ipswich has been suggested as a group activity for 1957. New members of the group include R. Clearey, B. Webby, D. Greenhalgh, M. J. Hunwick, J. Kimber and E. Adams, an ex-C.F.S. pilot who is to assist with the instructing.

THE Armstrong Siddeley Flying Club's Tipsy logged 35 hours during October, seven hours of which were flown on one day. A recent visitor to the club was Miss Jean Bird, ex-C.F.I. of the Experimental Flying Group.

GEMINI conversion illustrated above is that of charter operator W. E. James of Bankstown Aerodrome, Sydney, Australia, and incorporates 130 h.p. Lycoming 0-290-3 engines in place of Cirrus Minors. It is reported that take-off of the new variant is appreciably shorter, the climb is improved, and the cruising speed has risen some 20 m.p.h. to 140 m.p.h. The horizontally opposed four-cylinder Lycomings are also claimed to be somewhat smoother than the Cirrus Minors.

THURSDAY-EVENING night flying has begun at Fair Oaks Aero Club where, in spite the fact that the club was closed for the annual holiday during the first week of the month, 289 paid flying hours were logged during October. Messrs. Fortescue, Wilson, Lewis, Whitehead, Marriott and Wright have obtained P.P.Ls, and recent first soloists include Messrs. Buckwell and Serrell. A series of lectures and films on P.P.L. subjects begins on November 28.

SURREY Flying Club's Christmas party, at which their friends on Croydon Airport are entertained to buffet supper, films and dancing, will be held this year on December 15 at 8 p.m. in the club-house.

DECEMBER 15 is also the date of the British Women Pilots Association's Christmas party, to be held at the Kronfeld Club, 74 Eccleston Square, London, S.W.1, at 7 p.m. The constitution of the Association is expected soon to be finalized and approved.

MOUNTAIN-FLYING METEOR

RECENTLY delivered to a Swiss customer is the first of a series of "mountain-flying" versions of the Italian Meteor 55B four-seater. Powered by a 150 h.p. Lycoming engine, the new variant incorporates hydraulically retractable metal skis and is intended for mountain operations involving landings on snow-covered slopes and on glaciers.

The Swiss purchase was made after comparison tests with a Piper Cub at Samadan Airfield, St. Moritz and, it is stated, the Meteor was selected for its additional passenger/stretcher accommodation. Trial landings were made on the Bernina glaciers and on the Korvasch mountains at heights of over 9,000ft. Take-off and landing runs (fully loaded) are said to be 395ft, with a rate of climb of almost 1,400ft/min and a ceiling of 23,000ft.

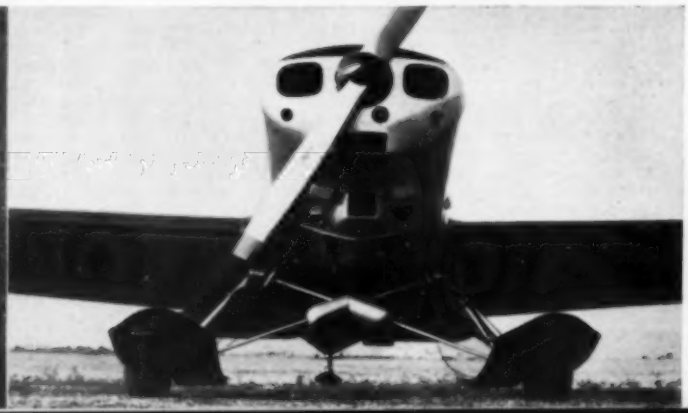
Meteor 55B (150 h.p. Lycoming)

Weights and Dimensions.—Empty weight, 990 lb; useful load, 770 lb; gross weight, 1,760 lb; span, 32.3ft; wing area, 155 sq ft; wing loading, 11.35 lb/sq ft; power loading, 11.7 lb/h.p.

Performance with 580 kg (1,280 lb) total weight (pilot only, 2 hr 30 min endurance).—Top speed, 130 m.p.h.; cruising speed, 115 m.p.h.; stalling speed, 34 m.p.h.; take-off run (with flaps and brakes), 230ft; landing run (with flaps and brakes), 260ft; climb to 1,000 m (3,280ft), 2 min 22 sec; service ceiling, 24,600ft.

Performance with 800 kg (1,764 lb) total weight (pilot plus 3 passengers, 2 hr 30 min endurance).—Top speed, 127 m.p.h.; cruising speed, 112 m.p.h.; stalling speed, 49 m.p.h.; take-off run (with flaps and brakes), 395ft; landing run (with flaps and brakes), 425ft; climb to 1,000 m (3,280ft), 4 min 10 sec; service ceiling, 19,700ft.

Right, the Italian Meteor 55B four-seater (see news item above). Below and at lower right are shown details of the wheel/ski undercarriage.



THE INDUSTRY

Canadair Appointments

NEW members of the General Atomic Division of Canadair, Ltd., Montreal, are Mr. A. M. Harris, Dr. W. D. Bennett, Dr. A. J. Goodjohn and Dr. J. T. Rogers. Mr. Harris is section chief for nuclear engineering; Dr. Bennett is acting chief of the development section; Dr. Goodjohn is working on special calculations on all projects; and Dr. Rogers is in charge of mechanical engineering and thermal problems on nuclear projects.

The Canadair atomic division is at present building a "swimming pool" type of test reactor for Atomic Energy of Canada, Ltd., at Chalk River, Ontario, and is working on several other nuclear projects.

Sir Gordon Harvey Joins G.Q.

THE G.Q. Parachute Co., Ltd., Woking, Surrey, announce that Air Marshal Sir Gordon Harvey, K.B.E., C.B., who recently retired from the R.A.F. when A.O.C-in-C. Maintenance Command, has joined their staff and will be chiefly concerned with research and technical development.

Air Marshal Harvey, who for over two years during the war commanded the Airborne Forces Experimental Establishment at Ringway and later at Sherburn-in-Elmet, was responsible for training Britain's first paratroops and for the development of Airborne Forces' equipment and new techniques connected with the build-up of the Glider Force. He subsequently held a number of senior posts, including those of Chief Engineer to Transport Command, Senior Technical Staff Officer to Technical Training Command and A.O.C-in-C. Maintenance Command.

Air Marshal Sir Gordon Harvey.

Dowty Prizegiving

SPEAKING at the annual prizegiving to Dowty Group apprentices at Arle Court, Cheltenham, recently, Sir Arnold Hall, technical director of the Hawker Siddeley Group and formerly director of the Royal Aircraft Establishment, Farnborough, said that a hundred years ago people were writing about the "dreadful state" of technical education in this country. But in the last century we had managed to do more in the engineering world than any other country, despite our small resources.

Mr. K. J. Hume, Group education officer, said that under the Dowty training scheme there had been more than 70 per cent passes in examinations and 20 National Certificates had been awarded.

Among the prizewinners introduced by Mr. D. M. Mann, education officer, were the following:—

First year apprentices, D. Birch, M. Griffiths; 2nd year, D. Parry, Mr. Mackenzie; 3rd year, J. Chase, M. Crouch; 4th year, R. Blake, R. Attwood; 5th year, A. Jordan, R. Shayler.

Plant Department Progress Prize: C. Page; Production Engineering Apprentice Prize: M. Hickman; Coventry Precision, Ltd., Apprentice Prize: M. Bird (sen.), P. Sanderson (jun.); New Mendip Engineering, Ltd., Prize: A. Sawyer (sen.), L. Bealing (jun.); Commercial Training Prize: H. Dutton.

Aboard the "Magga Dan," which sailed from London on November 15 with the British Trans-Antarctic Expedition aboard, was an Otter which has been Cocooned by the well-known R.A. Brand process. The plastic skin, which will protect this valuable deck-cargo from the effects of salt spray and weather, is seen being applied by spray-gun. Also on board was one of the Auster Mk 7s which guided "Theron" through the Antarctic ice early this year.

Vickers-Armstrongs World Posts

THE directors of Vickers-Armstrongs, Inc., have announced the appointment of Mr. R. H. Botterill as general manager, with effect from November 1. He was previously manager, engineering, with offices in Washington, D.C. Mr. F. R. Chilman will continue as secretary/treasurer.

After wartime service in the Royal Navy as an engineer officer, Mr. Botterill joined B.E.A.'s production and development branch in 1946 and was closely concerned with the introduction into service of the Viking, and later the Viscount. He joined Vickers-Armstrongs (Aircraft), Ltd., at Weybridge in 1954 and transferred to Vickers-Armstrongs, Inc., in January 1956.

From Vickers-Armstrongs (Aircraft), Ltd., comes news that Mr. E. J. Cockell, formerly with the Vickers-Armstrongs, Inc., after-sales organization in the United States, has been appointed their technical liaison representative in the Middle East. He is to take up this appointment next January.

IN BRIEF

Revised British Standards, B.S. 2SP. 101-104, for turnbarrels, tension rods and swaged cable-end connections (unified threads) for aircraft have been published by the British Standards Institution. Items with No. 8-32 UNC and No. 10-32 UNF threads have now been provided for in the standards, which thus present users with a complete range of aircraft cable-end connections with unified threads. Copies of the revised standards, published in one document, are obtainable from the B.S.I. Sales Department, 2, Park Street, London, W.1, price 5s.

* * *

The D.H. public relations department has announced the setting up of public relations offices at the de Havilland Engine Co., Ltd., Leavesden, and at de Havilland Propellers, Ltd., Hatfield. Mr. John K. Brown has been appointed public relations officer at Leavesden and Mr. John A. Loader at the propeller company. The work of both offices will be co-ordinated by the main public relations department under Mr. Martin Sharp.

* * *

A new company, known as Sound Control, Ltd., has been formed by the Thermotank Group to provide architects, designers, engineers and industry in general with a complete service covering all aspects of architectural acoustics. Its activities will include noise investigation and analysis; the planning, manufacture and installation of equipment designed to obtain the maximum possible noise reduction and to ensure the maximum control of transmitted sound; and the acoustic correction of auditoria and other rooms. Under the managing directorship of Mr. Douglas G. Smart, the new company will operate from Colneside Works, West Drayton, Middx.

* * *

The Machine Tool Trades Association, formerly at Victoria House, Southampton Row, London, W.C.1, has now moved to Brettenham House, Lancaster Place, London, W.C.2 (Temple Bar 3606/8).

Mr. L. F. Manser, who has joined the export sales department of the Rolls-Royce aero engine division. During the war he served in the R.A.F. as a flying control officer with Bomber, Transport and Training Commands at home and overseas. On demobilization he joined British European Airways and since 1948 has held appointments as station superintendent in Spain and Germany. Mr. Manser will be principally concerned with Rolls-Royce sales liaison in the U.S.A., Central and South America.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Another U-2 Sighting

ON November 12, at about 11.10 a.m., I saw what I believe was a Lockheed U-2. The aircraft flew around about Farnborough airfield for about 20 minutes and made off when two Hunters joined the Farnborough circuit—although this may be only coincidence.

Its description, as far as I could see, followed very closely that given by Messrs. Gates and Farrant in your issue of November 9, but the fact that the machine was flying just above low and patchy cloud made accurate observation difficult.

At first sight the aircraft appeared to be similar to a Sea Hawk, but on closer observation it could be seen that the wing was of higher aspect-ratio, and the engine noise was quite unlike that of a Sea Hawk at that speed (about 200-250 m.p.h.), there being no "whine."

When several miles distant the aircraft turned and the fin appeared to be similar to that of a Panther, although this may be an illusion caused by the distance.

Farnborough, Hants. TIMOTHY C. CARBURY.

[New information about the U-2 is given on page 809.—Ed.]

Window Revolution

VERY briefly mentioned in the end paragraph of "Test of Friendship" on page 737 of *Flight* of November 2 is a principle entirely new and of very great importance to aviation. I quote: "An unusual feature of the window design is that the pane is *encastré* with the skin and window frame and acts as a membrane."

If the tests are as successful as the makers claim, then widespread application of the principle renders redundant the vast amount of work which many in aircraft structures, and a few outside it, have devoted to establishing, proving and demonstrating the "neutral hole" principle.

Indeed, Fokkers appear to have achieved at one stroke a close approximation to the highly desirable state of "even" stress distribution in the membrane of their pressure hull, regardless of all openings and interruptions.

Now there remains only the elimination of riveted joints. . . .

London, N.W.5. W. D. PERRETT.

B.O.A.C.'s Future Equipment

WITH the ordering of Boeing 707s B.O.A.C. are now the only airline in the world proposing to offer a combined fleet of jet and turboprop types for long-haul work. Here, surely, is a great opportunity to prove the potentials of such a combination. There must be continued development of the Britannia, advantage being taken of the new Orion's enormous potential in the design of a stretched 450 m.p.h. version with which B.O.A.C. could inaugurate their Blue Riband turboprop and jet partnership in 1960.

It has been suggested by some that the long-range propeller-turbine transport represents an interim type, bridging the gap between the piston-engined airliner and the subsonic jet. On the contrary, with the development of large supersonic aircraft, the big and demanding long-haul jetliner as we know it today may rapidly lose its competitive position; but the turboprop, being the only form of powerplant at present in prospect which can enable an aeroplane of practical size to lift a really large payload over very long range, will see service in its advanced form well into the supersonic era.

We must consolidate our undoubted lead in the development of this type of powerplant by squeezing from it the last ounce of potential. If sufficient effort is forthcoming, the Britannia family and its successors, developed in both passenger and freight forms, may well be the most dominating transport aircraft during the 1960s.

Malvern, Worcs. D. W. SUTHERLAND.

NEARLY two years ago the Government announced a reduction in the number of projects to be undertaken by the aircraft industry. Accordingly the promising design of the Vickers 1000 and its civil version the VC-7, which had almost reached the prototype stage, was scrapped. It was expected that the VC-7 would be in operation with B.O.A.C. in 1960, but now the Corporation has had to resort to buying Boeing 707s with valuable dollars. Further, the project of the V.1000 was halfway through its course from drawing board to operation, a prototype being very near completion, while over £4 million had been spent on the whole development. All this was scrapped as if of little consequence.

Bearing this in mind we now see the announcement of a de Havilland project, the D.H.118, whose performance is to be nearly the same as the ill-fated VC-7. Yet it will not be ready until 1962, by which time the only market for it will be B.O.A.C., since other potential operators will have equipped themselves with DC-8s and Boeing 707s.

Does all this show good planning, competence and common sense? There will, of course, be those people who praise the British aircraft industry because it is putting a new aeroplane on the market. But at an enormous cost.

The most tedious part of the work for one aircraft has already been scrapped, a pure waste of money, of technical skill, and of valuable resources. Now the process of designing, of testing, of investigation and of building has to be gone through again. Is this good business, or another mere fantasy? The de Havilland project is in fact a second attempt to build a long-range jet to compete with the Americans. We started in the lead, we then faltered and we are now resuming the task, though after the Americans have overtaken us.

And what about the Comet? Is it to be relegated to the background as soon as present orders are completed? The resources of the de Havilland Company have already been taxed to a limit by resurrecting such a fine aeroplane as the Comet. But we now learn that they are to begin a second major project, when we have been told that the industry is tackling too many at once. This is an obvious inconsistency. Rather, why is not the energy devoted to developing the Comet, and achieving a full order book? At least, if another project is to be started, why don't we set our sights high and build something that will completely overleap American designs, instead of machines that are in the same class of performance?

Shrewsbury. R. E. GILL.

The Sopwith 1½-Strutter

REFERENCE the recent article on the Sopwith 1½-Strutter by Mr. J. M. Bruce, perhaps the following information may be of interest to your other readers.

Sopwith 1½-Strutters A.1020 and B.2576: While on reconnaissance six Sopwith 1½-Strutters of 45 Sqn., R.F.C. led by Capt. G. H. Cock, M.C., were attacked by eight Albatros Scouts (D3s) of Jagdstaffel 11. During the engagement one 1½-Strutter (Serial unknown, pilot unknown, observer Sgt. Fletcher) went down in flames; this was the seventh and last victory of Lt. Niederhoff. A.1020 also went down, and this was the ninth victory of Lt. Brauneck. Sopwith 1½-Strutter B.2576 (Capt. Cock and Sgt. Moore) was claimed by three members of Jagdstaffel 11, Oblt. Reinhard, Lt. Deilmann, and Sgt. Kullmer, who all said they had fired the fatal burst; but the credit was given to Reinhard—his first victory of a final score of twenty.

Capt. Cock, who scored seventeen victories, and his observer Sgt. Moore, who claimed fourteen victories, survived the war; I believe that until 1939 they were still in the Royal Air Force.

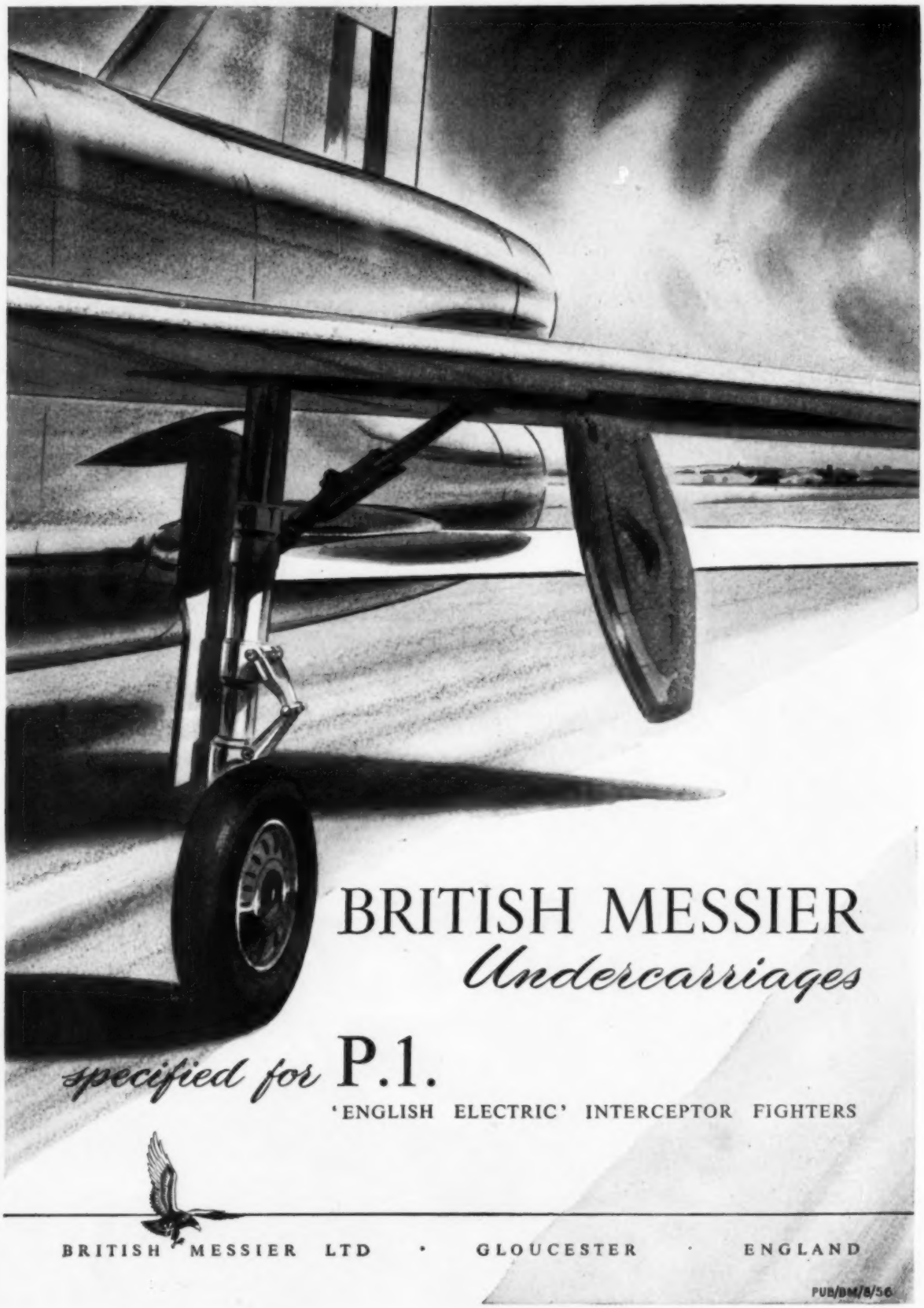
Littleover, Derby. DOUGLASS WHETTON.

INFRA-RED POSSIBILITIES

(*continued from p. 827*)

times more sensitive than the German war-time cell. The sensitivity of a modern lead-sulphide cell is such that, mounted in a telescope, it can detect the heat from stars; and the published figures of sensitivity would indicate that even with a mirror as small as three inches it would detect the heat from a domestic two-kilowatt electric fire at about ten miles range. Possibly as important is the fact that by reason of the very short response-time and high sensitivity of photo-conductor detectors it becomes possible to detect very small changes in temperature with a scanning system, and hence to build a thermal picture.

In addition to possible military applications, modern infra-red techniques, particularly photo-conductive detectors, have made their mark in a number of scientific and industrial fields. For example, the vibration and rotation of molecules gives rise to absorption bands in the infra-red. By the measurement of the wavelength and intensity of these absorption bands a great deal of information on the structure and size of molecules is possible. Dr. H. W. Thompson of Oxford University has for some time, led the world in these techniques, and many molecules of interest to human life and to industry have been investigated. In astronomy it is possible to measure and study the infra-red radiation from stars.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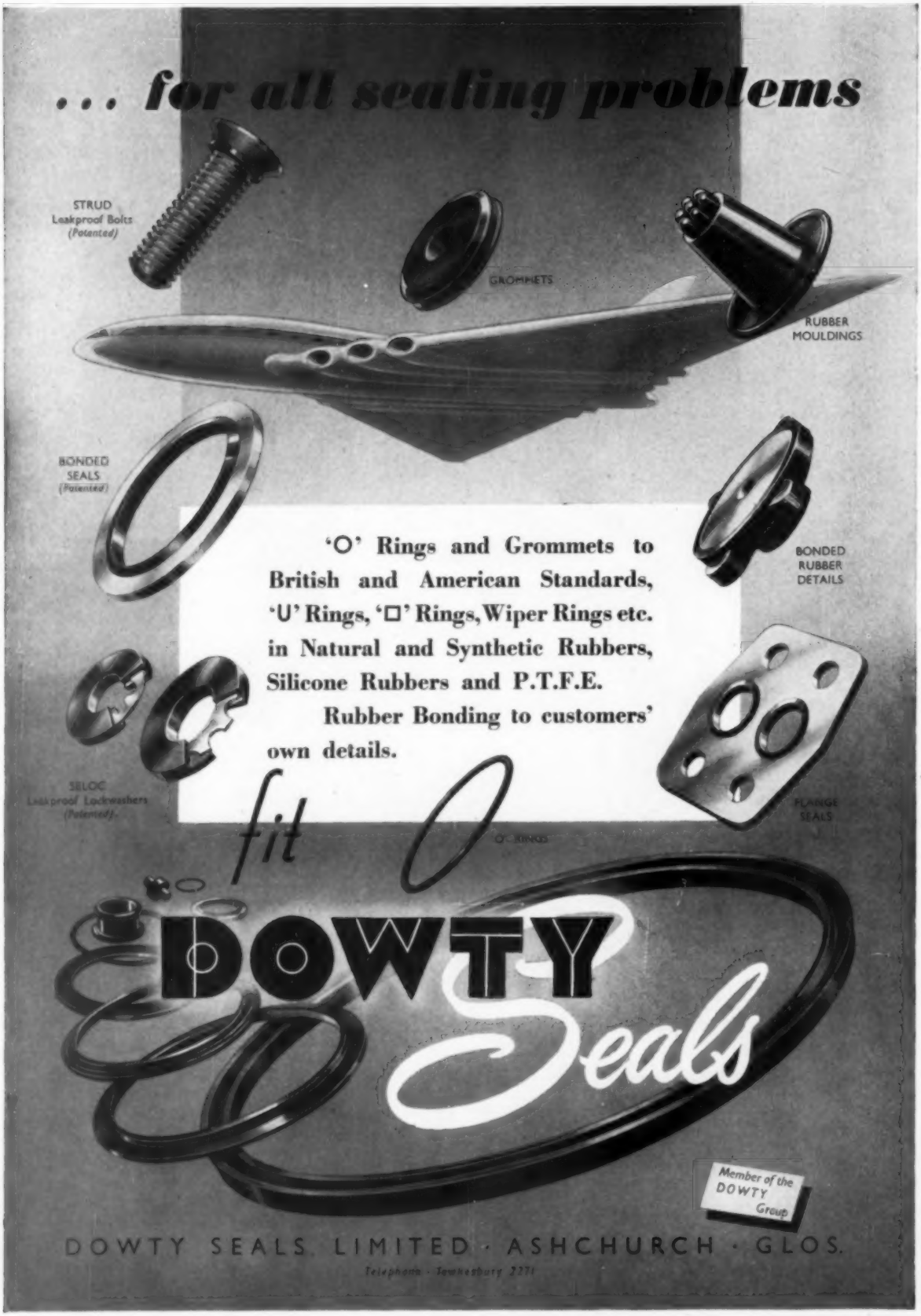
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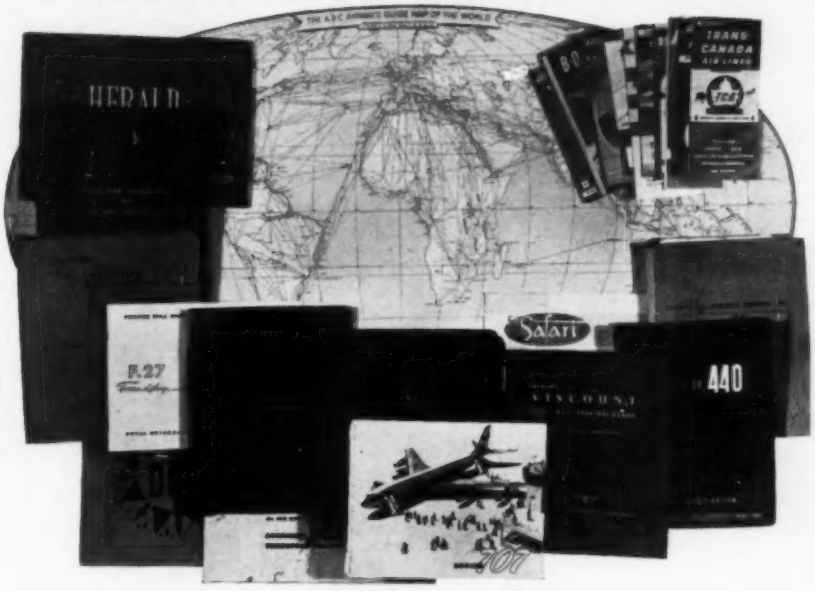


THE HUNGRY AIRLINES

An Examination of Traffic and Transports in 1962

PART 1: THE WORLD MARKET

A "FLIGHT" ANALYSIS BY J. M. RAMSDEN AND A. T. PUGH

IT would be easy to devote a whole issue of *Flight* to a summary of the countless words spoken and written in 1956 on the subject of the airline industry's prodigious buying spree. "The airlines will be losing their shirts," predicted the American business magazine *Fortune*. "This gloomy prediction is mistaken," rejoined C. R. Smith, president of American Airlines. And again: "I want a short article about the possibility of the Atlantic getting choked with seats if everybody buys these damn big jets," ordered Sir William Hildred, director-general of the International Transport Association. "No need for panic . . . there will still be an important margin between supply and demand," replied M. Gilbert Perier, of I.A.T.A.'s executive committee.

The International Civil Aviation Organization, curator of all the world's traffic figures, and thus qualified to comment, were non-committal. In their annual report, they simply said: "Whether the traffic . . . will expand rapidly enough to keep pace with the re-equipment programme is, of course, a matter of conjecture."

Note the words "of course." They seem discreetly to imply that anyone who attempts to calculate the balance between future traffic and future capacity will probably come up with results that are wide of the mark.

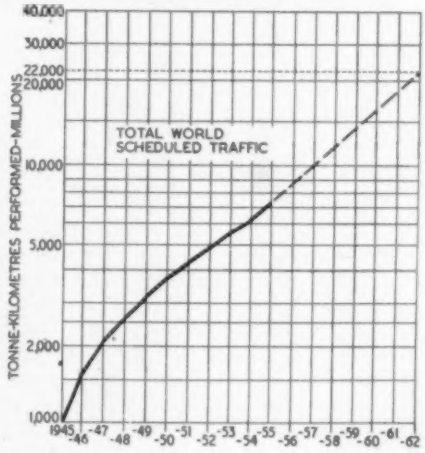
This has in fact been proved time and time again. One has only to glance at past forecasts to see just how inaccurate the most responsible and painstaking researches have been. To take the U.S. domestic market as an example, Curtiss-Wright proved to be nearly 1,000 million passenger-miles, or 12 per cent, short in their 1944 estimate of traffic in 1950. Similarly, the Port of New York Authority, estimating in 1950 the 1955 passenger-miles, were 45 per cent too conservative. The same study forecast a U.S. passenger-mileage figure for 1980 that had already been exceeded in the first half of 1956. The lesson of these and other past estimates is clear: the growth in traffic has almost invariably been underrated.

Nevertheless, the traffic-prophets are irrepressible, and will ever be so. Every airline has them, and upon their joint estimates depends the prosperity of the world's aircraft manufacturers. No one knows what their combined estimate ever is; most airlines, for obvious business reasons, keep their researches under lock and key. But to challenge the accuracy of their traffic calculations is the indisputable fact that, on the strength of them, the airlines have ordered £750 million's worth of new equipment in the last twelve months. This kind of buying is without precedent in air-transport history. Will the airlines lose their shirts as a result, or is there in fact no need for panic?

To answer this question one can turn to the curve of traffic growth since the war, extrapolate it to the sixties, work out the total transport capacity available in that period, and measure one against the other. Obviously this is not so simple as it sounds: if it were, there would not be such widely varying opinions about the future. But—respectfully aware of the pitfalls—we now venture upon this fascinating ground.

The conclusions to which we come provide a broad measure of the prospects for the airlines. What of the prospects for the world's dozen major transport manufacturers? Is the market big enough for them all to share profitably? Or will some fall by the wayside? In particular, since the medium-haul market is of such special concern to the British industry, is there enough room for the Comet, Britannia and Vanguard, as well as all the foreign contenders—the Electra, Convair 880, Caravelle, Boeing 727 and DC-9? It is with this provocative question that the sequel to the present analysis will be concerned.

We should have liked to answer, also, an even more tantalizing question: How will the medium-haul market in 1962 (or thereabouts) be shared between jet and turboprop? Obviously the two conflicting ideologies will co-exist—but what will be the balance of power? It is upon this question that so many medium-haul carriers are now searching their hearts and their route-studies. Most of the long-haulers have chosen to worship at the shrine of the jet, but in the medium-haul field we have the curious *impasse* in which few orders are being placed (14 aircraft in the last five months) while the betwixt-and-between airlines ponder which way to swing. The issue is simple to state, but seemingly impossible to resolve except by "hunch" methods. Shall we, the airlines ask themselves, order turboprops for their



Plotted to a logarithmic vertical scale, this curve shows (full line) the growth of scheduled international and domestic air traffic (passengers, freight and mail) carried since 1945, and (broken line) an extrapolation to 1962 at the same average annual rate of increase since the year 1948.

The shape which has brought about a drastic re-appraisal of long-range air transport and of the industry which supplies its equipment.

THE HUNGRY AIRLINES . . .

superior operating economy, or jets because our competitors might buy them?

But there is a basis for analyzing the *general* market, and the quantities in which it may absorb both forms of transport. It is with this that the sequel to the present article will be concerned.

For the moment, however, the question we shall attempt to answer is: What is the likely balance between traffic and capacity in 1962 on the basis of present orders?

Traffic and Transports in 1962.—Post-war traffic figures show that the average rate of increase since 1948 has been 16.6 per cent; in other words, traffic has been doubling itself about every five years. In extrapolating this curve to the year 1962, should our rate climb be the same, higher, or lower? Whichever gradient we choose, our reasons must be clearly stated.

A substantial *increase* in slope could be assumed if it were accepted that fare-reductions, such as those to be adopted on the North Atlantic in 1958, will become widespread, and that

THE AIRLINES' SHOPPING LIST

Correct to November 19, 1956, excluding options but including certain government and corporate orders

Aircraft	Variant	Powerplant	Airlines (listed in order of purchasing)	Total
Douglas DC-8	Overseas or Long-Range	Pratt and Whitney JT4	PanAm,* 21 (Dec. 1959); United, 15 (May 1959); K.L.M., 8 (March 1960); Eastern, 18 (May 1959); I.A.L., 4 (1960); S.A.S., 7 (1960); Panagra, 4 (early 1960); Swissair, 3 (first half 1960, the third in 1961)	111
	Domestic	Rolls-Royce Conway	T.C.A., 4 (early 1960)	
	Domestic	Pratt and Whitney JT3	United, 15 (May 1959); National, 6 (Midsummer 1959); Delta, 6 (June 1959)	
Boeing 707	120	Pratt and Whitney JT3	PanAm, 6 (Dec. 1958); American, 30 (operation on June 15, 1959); Continental, 4 (May 1959); T.W.A., 9 (April 1959); Qantas, 7 (Type 138, May to September 1959)	132
	220	Pratt and Whitney JT4	Braniff, 5 (Oct. 1959); Sabena, 4 (Dec. 1959)	
	320	Pratt and Whitney JT4	PanAm, 17 (March 1959); T.W.A., 18 (April 1959); Air France, 10 (Nov. 1959)	
	420	Rolls-Royce Conway	Lufthansa, 4 (Summer 1960); Air-India, 3 (early 1960); B.O.A.C., 15 (1960)	
Bristol Britannia	102	Proteus 705	B.O.A.C., 15 (current delivery)	56
	250	Proteus 755	R.A.F. Transport Command, 10; M. of S., 3	
	300-series	Proteus 755	M. of S., 1; B.O.A.C., 7	
	310-series	Proteus 755	B.O.A.C., 11; El Al, 3; C.P.A.L., 5; Hunting-Clan, 1	
Douglas DC-7C Seven Seas	—	Wright R-3350	PanAm, 27 (current delivery); Swissair, 4 (current); S.A.S., 14 (current); Sabena, 9 (current); Braniff, 7 (summer 1956); B.O.A.C., 10 (October 1956); K.L.M., 10 (1957); Northwest, 8; R.E.A.L., 3; Panair do Brasil, 4; Alitalia, 4; C.M.A., 4; J.A.L., 4	111
Lockheed L.1649A Super Star Constellation	—	Wright R-3350	T.W.A., 24; Air France, 12; L.A.I., 4; Lufthansa, 4; Varig, 2 (Dec. 1957)	46
Convair 440 Metropolitan	—	Pratt and Whitney R-2800	R.E.A.L., 8; S.A.S., 16 (March 1956); Finnair, 2 (Feb. 1956 and Feb. 1957); Sabena, 12; Swissair, 11 (June 1956); Iberia, 5; Continental, 3 (Feb. 1956); National, 6; Delta, 8 (Jan. 1957); Eastern, 15 (May 1957); Braniff, 5; Alitalia, 2; Yugoslav Airlines, 1; Lufthansa, 2 (March 1957); Air Carrier Service, 2; R.A.A.F., 2; U.S.A.F., 6; Corporate customers, 9; Karhumaki Airways, 1 (June 1957); Ansett, 1 (June 1957); Italian A.F., 1 (July 1957); others 7.	125
Sud-Est Caravelle		Rolls-Royce Avon RA.29	Air France, 12 (1958)	12
de Havilland Comet	4	Rolls-Royce Avon RA.29	B.O.A.C., 19 (mid-1958); Capital, 4 (Nov. 1958)	33
	4A	Rolls-Royce Avon RA.29	Capital, 10 (June 1959)	
Lockheed Electra		Allison 501	American, 35 (Aug. 1958); Eastern, 40 (Aug. 1958); Braniff, 9 (May 1959); National, 23 (April 1959); K.L.M., 12 (Sept. 1959); Western, 9 (late 1959)	128
Vickers Viscount	700 & 800 series	Rolls-Royce Dart	*See list below*	357
Vickers Vanguard	V.951	Rolls-Royce Tyne	B.E.A., 20 (March 1960)	20
Convair 880 Jetliner		General Electric CJ-805	T.W.A., 30 (late 1959); Delta, 10 (1959)	40
Fokker F.27 Friendship	Fokker-built	Rolls-Royce Dart 511	K.L.M., 4; Aer Lingus, 5 (late 1958); T.A.A., 6 (early 1959); Netherlands Government, 1; executive model for an Italian company, 1; Braathens, 3; "Australian purchaser," 2; B.K.S., 2	53
	Fairchild-built		West Coast Airlines, 4 (Nov. 1957); Mackay, 2 (Oct. 1957); Frontier, 2 (Oct. 1958); Bonanza, 3 (Feb. 1958); Piedmont, 12 (late 1957); General Tire and Rubber Co., 1 (1958); Continental Can Co., 1 (1958); Quebecair, 2 (early 1958); "American purchasers," 2	
Handley Page Herald		Alvis Leonides Major	Queensland Airlines, A.N.A., and Lloyd Aero Colombiano—29; Air Kruise, 6	35
Frye Safari		Wright R-1300 or Pratt and Whitney R-1340	Wien Alaska, 3 (June 1957); Northern Consolidated, 3 (June 1957); Cruzeiro do Sul, 10 (end of 1957); Samoan Airlines, 2 (1958)	18

* An unspecified proportion of this total will be JT3 versions.

Vickers-Armstrongs Viscount (all models). The following list of confirmed orders accounts for 357 aircraft, as follows: B.E.A., 26 V.701 (Dart 505), 1 V.701 (Dart 506), 24 V.802 (Dart 510), 14 V.806 (Dart 520); B.W.I.A., 4 V.702 (Dart 506); Aer Lingus, 4 V.707 (Dart 505), 3 V.808 (Dart 510); Air France, 12 V.708 (Dart 505); T.A.A., 6 V.720 (Dart 505/6), 1 V.720 (Dart 506), 5 V.756 (Dart 510), 2 V.816 (Dart 525); Indian Government, 1 V.723 (Dart 506), 1 V.730 (Dart 506); T.C.A., 15 V.724 (Dart 506), 21 V.757 (Dart 506); Hunting Clan, 3 V.732 (Dart 506), 2 V.759 (Dart 510); Pakistan Government, 1 V.734 (Dart 506); Iraqi Airways, 3 V.735 (Dart 510), 1 V.773 (Dart 510); Fred Olsen, 2 V.736 (Dart 506), 4 V.779 (Dart 510); Canadian Government, 1 V.737 (Dart 506); Misrair, 3 V.739 (Dart 506); Braathens, 1 V.742 (Dart 510); Capital, 3 V.744 (Dart 506), 72 V.745 (Dart 510); Butler Air Transport, 2 V.747 (Dart 506); Central African Airways, 5 V.748 (Dart 510); L.A.V., 3 V.749 (Dart 506); B.O.A.C., 8 V.754 (Dart 510), 4 V.772 (Dart 506); Hong Kong, 2 V.760 (Dart 510); U.B.A., 3 V.761 (Dart 510); Hughes Tool Co., 1 V.763 (Dart 510); U.S. Steel Corp., 3 V.764 (Dart 510); Standard Oil, 1 V.765 (Dart 510); Indian Airlines, 10 V.768 (Dart 510); K.L.M., 9 V.803 (Dart 510); Transair, 2 V.804 (Dart 510); New Zealand N.A.C., 3 V.807 (Dart 510); Continental, 15 V.812 (Dart 525); Air Austria, 4 V.803 (Dart 510); South African Airways, 7 V.813 (Dart 525); Iranian Government, 3 V.782 (Dart 510); Lufthansa, 7 V.814 (Dart 525); Philippine Air Lines, 2 V.784 (Dart 510); L.A.I., 6 V.785 (Dart 510); South African Government, 1 V.781 (Dart 510); Pakistan Air Lines, 3 V.815 (Dart 525); Cubana, 3 V.755 (Dart 510), 4 V.818 (Dart 525); Lloyd Aero Colombiano, 3 V.770 (Dart 510); Brazilian Government, 1 V.770 (Dart 510); P.L.U.N.A., 3 V.770 (Dart 510); Niarchos, 1.

At present unfamiliar, the silhouette of the Fokker Friendship will shortly be seen in many countries. This excellent local-service machine will also be made by Fairchild. (Below) Backbone of the air-transport economy of much of the world, the DC-3 has an almost unnatural propensity for "going on going on." In 1962 it may still be taking a fair part of the world's traffic, and correspondingly fewer new machines will be sold in consequence.

a substantial new market will result. We shall, undoubtedly, see a steady decline in fare-levels over the years, as the air transport industry re-equips with more efficient aircraft tools with which to manufacture its ton-miles. Yet there is no sign that other production costs can be held down to enable full advantage to be taken of more economical equipment. And there is no evidence to encourage the belief that a widespread reduction of air-transport prices will in fact attract the mass market needed to increase the margin of profit—a margin which, it must be remembered, is only about one per cent of turnover for the whole industry.

The only airline experience of the effect of substantial fare-reductions was that provided by the introduction of tourism in 1951. Five years later it is perhaps 40 per cent of the world total, and in the country of tourist travel's origin—the U.S.A.—35 per cent. Tourism did not result in a marked increase in world traffic and in airline revenues—indeed in Europe, as Mr. Wheatcroft's study showed (*Flight*, July 13 and 20) there was some disillusionment about the lower revenues which persisted after the introduction of tourist rates.

We do not therefore feel it is reasonable to assume that fare-reductions will steepen the traffic curve between now and 1962.

What else might? Possibly, the opening up to western airlines of international flights to the U.S.S.R. and China. This is already happening, but it is impossible to predict the likely extent of these new markets. Certainly no airline can with justification equip in anticipation of big business beyond the Iron Curtain. But, so likely is the possibility of some (perhaps considerable) extra business, that we would not be justified in assuming that the traffic gradient for the next six years will seriously, or even slightly, decline.

It would, we feel, be reasonable to assume that the gradient will continue at the 1948-1955 average of 16.6 per cent. But, bearing in mind the lessons learned from the pessimism of previous traffic prophets, the round figure upon which we shall base our prediction is 17 per cent.

Extrapolating the traffic curve at this slope to the year 1962, we arrive at a figure of approximately 22,000 million tonne-km.

We now have a basis for assessing the aircraft capacity required to haul this traffic—and whether the transports on order, plus the *remaining* present-day transports, will be sufficient to meet the demand.

Load factor, that useful measure of the air transport industry's health, has over the past few years remained remarkably steady among I.A.T.A. carriers at about 60 per cent. This would seem to represent a reasonable balance between supply and demand. A higher figure would suggest a shortage of capacity, and traffic being turned away; a lower figure would suggest over-capacity. Assuming, therefore, a load factor of 60 per cent, the capacity needed to carry our estimated 22,000 million tonne-km in 1962 will be approximately 37,000 million tonne-km.

Will all the new transports on order, plus remaining present-day transports, be sufficient to meet this?

The first conclusion of this analysis is that it will not—by the considerable margin of 11,000 million tonne-km.

And this assumes a 52 per cent survival of existing piston fleets. Even assuming that 75 per cent of present-day fleets are still in service in 1962, 7,400 million tonne-km of new aircraft capacity would still have to be ordered to meet the traffic demand. But, quite clearly, nothing like three-quarters of present-day airliners will still be in scheduled service six years hence. We believe, from the views being expressed by the big world operators, that the next few years will see a fast writing-off of piston-engine transports. Not simply because they will be wearing out (although many of those already six or more years old in 1956 will be), but because, to quote Mr. C. R. Smith, president of American Airlines: "It is an axiom in manufacturing that no existing tool, however new and good its physical condition, is an efficient tool if its original advantages have been surpassed by a better tool . . . That is why airlines . . . invest huge sums in new equipment when their existing machines are still in first-class operating condition."

It would, from a quick consideration, appear reasonable to assume that only 30 per cent of the existing world piston fleet is likely to be in scheduled service in any numbers in 1962. The remainder would be written off, or at work on non-scheduled operations—cargo, charter work etc. But a more careful consideration leads us to make a less drastic disposal of the present-day fleet. New transports are expensive: the majority of operators may feel as Mr. Smith does, but they will—with average profit margins remaining small—be less inclined to replace their existing fleets. They will, we feel, continue to squeeze out of them the last penny of value rather than invest in new, costly

(Left) Probably the most efficient large transport flying today—the Bristol Britannia. (Right) Typifying America's domination of the air transport market—Lockheed's L.1049 G Super Constellation.

TABLE 2—EXISTING WORLD FLEET

Employed on Commercial Scheduled Services: Correct to November 19, 1956

	Totals Nov. 1956 *Note 1*	Est. Totals 1962 *Note 2*	Capcty P'load (tonnes)	Block Speed (km/hr) *Note 3*	Typical Ut'lzn (hr) *Note 4*	1956 Capacity (tonne-km ×1,000,000)	1962 Capacity (tonne-km ×1,000,000)
Stratocruiser	50	3	10.6	365	2,500	485	29
L.049	67	10	8.6	325	2,850	535	80
L.649, 749, 749A ...	117	30	8.1	342	3,200	1,040	265
L.1049, C, D, E ...	97	60	11.0	350	3,250	1,220	735
L.1049 G, H	126*	88	12.0	350	3,200	1,700	960
DC-4	330	32	5.8	240	2,000	920	89
DC-6	160	60	7.6	336	2,850	1,165	436
DC-6A, B	320*	230	9.5	345	3,100	3,260	2,380
DC-7, 7B	200*	166	9.2	386	2,750	1,950	1,620
Convair 240	153	28	4.3	328	1,800	388	71
,, 340	186	80	5.7	324	2,250	775	333
Martin 202, 404 ...	122	23	4.0	288	2,450	345	650
North Star	43	5	7.1	278	3,450	295	35
DC-3	1100	300	2.9	216	1,500	1,935	282
Ambassador	19	10	5.0	300	1,900	54	29
Scandia	8	1	4.2	284	1,400	13	—
Viking	39	1	4.0	240	1,000	38	—
Rapide	49	1	1.0	158	750	6	—
Beaver	27	17	0.7	164	900	3	—
Heron	64	36	1.4	204	650	12	7
C-46	154	31	5.5	255	1,450	310	6
Freighter	55	20	4.8	200	1,100	5	2
(Viscount : see Table 3)	Aircraft total (round figures) capacity					15,500	8,000

NOTES—(1) From I.C.A.O. *Digest of Statistics* No. 57; *Flight*, January 20 and April 20; and manufacturers.
(2) See text for basis of estimates.
(3) Block speed assumed for all types as 0.75 × speed at 50 per cent take-off power. Basis of estimate: *A.B.C. World Airways Guide*, November 1956. See text.
(4) From I.C.A.O. *Digest of Statistics* No. 57 (see text). * Including backlog

THE HUNGRY AIRLINES . . .

and—an important point this—untried equipment. Even those who have ordered new transports may well hang on to sizeable fleets of their present airliners to do work for which the new equipment may not be justified.

In other words, the new generation of transports may have a tougher job to oust the older types than many people think.

It was with these thoughts in mind that we assessed the amount of existing capacity that would be in service in 1962 (Table 2). Our source was the I.C.A.O. *Digest of Statistics* No. 57 for 1954 (the latest available) brought up to date (see note 3, Table 2) to include new deliveries, and revised to account for accidents and transfer to non-scheduled operators. Each aircraft was individually considered on its merits (age, serviceability, efficiency, etc.) in "guesstimating" the quantity remaining in scheduled service six years hence. The results are the mean of three independent *Flight* staff assessments, which tallied remarkably closely for most types. The few exceptions were reconsidered. Utilizations shown are those actually being achieved (I.C.A.O. *Digest* No. 57). Average block speeds based upon 75 per cent of the T.A.S. at 50 per cent of the take-off power have been generally assumed, after reference to typical schedules actually achieved by each type according to *A.B.C. World Airways Guide*, November 1956.

From these calculations the amount of existing capacity still likely to be in scheduled service in 1962 is 8,000 million tonne-km—i.e., about 52 per cent of the present-day total of 15,500 million tonne-km.

We believe this to be reasonable: a 75 per cent disposal of present-day transports would be viewing the replacement market too optimistically, and *vice versa* for a 30 per cent disposal.

To this figure of 8,000 million tonne-km surviving capacity we must add the capacity represented by all the new transports now on order. This is shown in Table 3; it amounts to about 18,000 million tonne-km. Thus total capacity in 1962 will be 26,000 million tonne-km, **or 11,000 million tonne-km short of the amount required.**

What does this mean in terms of aircraft? Let us very roughly divide this still unfilled 11,000 million tonne-km into 30 per cent long-haul, 60 per cent medium-haul, and 10 per cent short-haul. In terms of aircraft, this works out as about 80 long-haul big jets (to be shared by two firms), 440 medium-haulers (eight firms), and 650 short-haulers (six firms). This is the scale of further business that the world's industry may reasonably expect to transact and complete by 1962. Our distribution amongst the three different categories of transport is purely arbitrary, and is given only to show that, taking the industry *as a whole*, there is plenty of business to go round. It is the medium-haul market in particular that the later part of this study will examine more precisely.

Perhaps we have been too optimistic in our assumptions? Let us therefore retrace them, assuming only a 15 per cent rise in traffic and only a 20 per cent disposal of existing transports. We still arrive at a required capacity in 1962 of 2,100 m tonne-km (15 big jets, 85 medium-haulers, 105 short-haulers).

Whichever one's viewpoint may be, the airlines do not appear to have over-ordered, as so many prophets have alleged. Nor do the manufacturers, viewed as a whole, appear to be putting too many new aircraft on the market. Indeed, the remarkable fact emerges that the airlines and the manufacturers, in making their separate estimates of the market, seem to have come up with an overall answer that makes sense. The airlines have still got some two years in which to place orders to meet their still unfilled capacity, and the manufacturers have enough business in prospect to keep them busy over the next six years. But their business will not stop in 1962. It needs only a glance at the traffic curve to realize that some very heavy orders will have to be placed to keep up with traffic demand throughout the sixties and beyond.

TABLE 3—NEW CAPACITY IN 1962

Ordered by Scheduled Airlines. Correct to November 19, 1956

	No. on Order	Capacity Payload (lb × 1,000)	Block Speed* (km/hr)	Total Capacity Payload (tonnes)	Assumed Utilization	Capacity (tonne-km ×1,000,000)
Boeing 707	132	(67 × 38 lb (65 × 31 lb	770†	2,060	3,000	4,750
DC-8	111	(25 × 34 lb (86 × 38 lb	750†	1,870	3,000	4,200
Douglas DC-7C	111	21.3	450†	1,050	3,000	1,450
Britannia (100, 300) ...	42	(15 × 21 lb (27 × 28 lb	490	485	3,000	715
Comet 4, 4a ...	33	(10 × 23 lb (23 × 19 lb	600	383	3,000	545
Lockheed 1649A	46	17	430†	354	3,000	460
Vanguard ...	20	23	480	203	3,000	300
Viscount (700, 800) ...	337‡	234 × 12 lb 103 × 13 lb	410	1,776	3,000	1,940
Electra	128	21.6	480	1,250	3,000	1,800
Friendship ...	47	9.3	290	198	2,000	115
Convair 880 ...	40	25	690	450	3,000	9 0
Metropolitan (440)	107	12.8	350	725	3,000	670
Herald	35	10.7	240	170	2,000	82
Safari	16	11.3	220	82	2,000	36
Caravelle ...	12	20.5	500	110	3,000	166
Total new capacity (round figures)						18,000

* Block speed assumed for all types (except those indicated †) as 0.75 × speed at 50 per cent take-off power. See text.

† Block speed assumed as 0.8 × speed at 50 per cent take-off power.

‡ Excluding executive orders, etc. 150 in service have been included in this table.

Two Rolls-Royce powered contenders—Comet and Viscount. Each will have a R-R. powered successor—D.H.118 and Vanguard.

CIVIL AVIATION

HARD WINTER AHEAD FOR B.E.A.

LAST week Lord Douglas, reviewing B.E.A.'s summer results, hinted that unless B.E.A. succeed in "beating our winter targets to offset the summer shortfall," and at the same time hold down costs, the Corporation is likely to end the financial year with a loss. The credit squeeze and the Middle East situation have been cited as the cause of unexpectedly low revenues.

The chief executive, Mr. Anthony Milward, remarked in a recent talk to Aviation Forum (see *Flight*, November 16) that since last November B.E.A. have not once attained the revenues for which they had budgeted. He added that "very little" could be done by European airlines in general to make up in the winter the amount by which they might fall short in the lucrative summer season. Nonetheless, this is what the Corporation will attempt to do during the coming months.

AIR TRANSPORT AND THE WORLD CRISIS

UNDER an agreement signed after nine hours of negotiations in Zurich, Swissair will place three of their six DC-6Bs at the disposal of the United Nations commander in Naples for the "neutral airlift" between Italy and Cairo. Each aircraft will make two round trips per day between Naples and Cairo, and Swissair expect to carry 400 U.N. troops to Egypt daily. The first batch was flown to Egypt by Swissair on November 16. Swissair and K.L.M. have resumed services into Cairo. They avoid the main runway, which has apparently been heavily damaged.

From I.A.T.A. comes news that a voluntary airlift of 60 tons of supplies for Hungary will be made by member airlines from New York.

Further help for Hungary is forthcoming from British independents: at the same time as Cambrian announced their readiness to put a DC-3 on Hungarian relief work (reported last week), Transair placed a DC-3 at the disposal of the Oxford Committee for Famine Relief. The aircraft left Croydon last Monday carrying three tons of clothing to Vienna, and was due to return the following afternoon with refugees. The flying of refugees to England from Vienna has also been carried out by Silver City under charter to private organizations.

Biggest independent contribution of all, perhaps, has been made by Eagle, who were the first into Vienna (with a Viking paid for by the company), and who have put ten aircraft—at cost—on to refugee evacuation and relief supplies work.

THE CORPORATIONS' BORROWING POWERS

DETAILS of the B.O.A.C. aircraft requirements were given to the House of Commons on Monday last by Mr. J. Profumo, Under-Secretary for Transport and Civil Aviation, when he moved the second reading of the Air Corporation's Bill. This measure will increase the maximum borrowing powers of B.O.A.C. from £80m to £160m and of B.E.A. from £35m to £60m.

Mr. Profumo said that B.O.A.C. would have reached the existing limit of £80m as a result of orders already placed. These were for 33 Britannias, 20 Comets, 10 DC-7Cs and 14 Viscounts. In addition it was proposed to order 15 Boeing 707s and a "substantial number" of D.H.118s. Until negotiations between B.O.A.C. and de Havilland were further advanced no precise estimate of the cost of the B.O.A.C. order for D.H.118s could be made, but it was possible to say that the combined cost of the Boeings and the D.H.118s might be in the order of £100m. [This indicates a D.H.118 order of at least 15 aircraft.]

Referring to B.E.A., Mr. Profumo said it was proposed also to order some "long-distance jet aircraft" and a small number of helicopters. He could not, however, state exactly how the extra £25m would be spent.

BREVITIES

THE Scottish Aviation Twin Pioneer received its full normal category Certificate of Airworthiness on November 16.

* * *

It is reported that extensions to the runways at London Airport to make them suitable for the Boeing 707 may cost £3m.

* * *

The Swiss Government are to spend about £4.4m on enlarging and modernizing Kloten international airport.

* * *

Trans-Australian Airlines made a record profit of £242,000 in 1955/56.

* * *

The South African Minister of Transport has agreed to the extension of the runway at East London Airport to "take the largest airliners in service."

* * *

The Government of Sierre Leone is considering plans for building a new airport.

* * *

An interchange travel agreement between New York and Jamaica has been concluded by B.O.A.C. and PanAm.

* * *

Landings and take-offs at Chicago Midway Airport reached 380,339 in the year ended September 1956. Miami, New York (La Guardia), Los Angeles, Atlanta, Denver and Charleston all had over 250,000 movements in the same period.

* * *

Air traffic controllers are numbered among the professional civil servants whose Institution has written to Mr. Harold Watkinson urging that the independent private inquiry into the Vulcan accident at London Airport should be held in public.

* * *

B.O.A.C.'s associate, British West Indian Airways, has incorporated the Airline Division of British Colonial Airlines, Inc., as a new company to be known as British Honduras Airways, Ltd. The fleet consists of four Cessnas.

* * *

Scandinavian Airlines System, which pioneered the world's first commercial air transport over the Arctic region, is now preparing to open a new 30-hr service between Copenhagen and Tokyo over the geographical North Pole on February 23 next. The service will be operated by DC-7Cs, one of which last week (on a delivery flight to S.A.S.) flew 6,000 miles non-stop from California to Stockholm.

The death occurred last Saturday of Mr. Bernard George Porter, administration director of B.O.A.C. and a past president of the Chartered Institute of Secretaries.

* * *

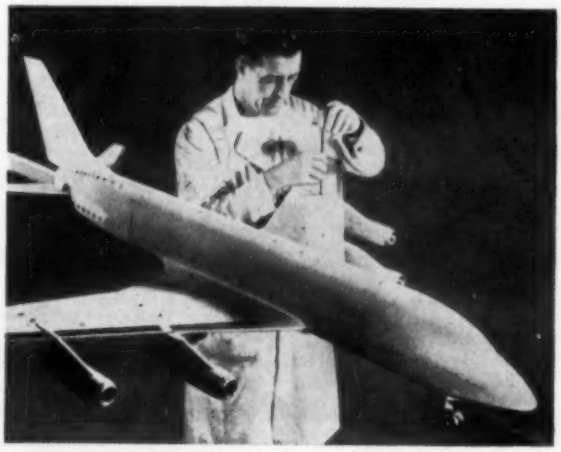
The third Viscount 800 made its first flight on November 7. By that date 127 test flights totalling 150 hr had been made on Viscount 800s.

* * *

Silver City announce a new "Saturday night out" service from Ferryfield to Ostend and return. The fare of £9 8s includes in-flight meals, dinner and cabaret, and overnight hotel accommodation.

* * *

The thirteen British pilots working for Arab Airways of Jordan are being replaced by pilots of other nationalities. Syria, Egypt and other Arab states will no longer allow British pilots to fly over their countries.



Still the only 600 m.p.h. medium jet for which orders have been announced (30 for T.W.A. and 10 for Delta), the Convair 880 has now reached the tunnel-testing stage. The model seen here is in the Convair wind tunnel at San Diego.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

R.A.F. Accident Rate

IN London on November 15 Air Marshal G. W. Tuttle, Deputy Chief of the Air Staff, said that it was "quite incredible" to see the way the accident rate in the R.A.F. kept decreasing, in spite of the increasing complexity of aircraft. This year, for the first time, aircrew errors were fewer than technical faults. The D.C.A.S. explained: "The reason for the decreasing accident rate is a high standard of training, improved methods of survival, and improved meteorological forecasting to meet the demands of an all-weather air force."

Airlift to Hungary

THE R.A.F.'s first three-day airlift by Transport Command took a total load of 116 tons of supplies to the International Red Cross in Vienna for distribution in Hungary. Twenty aircraft were involved, including Hastings and Valettas. The N.C.O.s and airmen at R.A.F. Wildenrath's air movements terminal handled the unloading of 50 lorries, which brought the supplies from Northern Army Group stores. The flights also included a trip by a Beverley—to Vienna with nine tons of medical supplies.

St. Clement Danes Concert

A CONCERT in aid of the fund to restore St. Clement Danes as the R.A.F. church and memorial shrine is being held at the Lyceum Theatre, London, on November 26 in the presence of H.R.H. the Duchess of Gloucester.

R.A.F. Unit Badges

AMONG badges and mottoes which the Queen has approved for R.A.F. units are those for R.A.F. Stations Wyton and Gaydon, and for No. 173 Squadron, based at Hawarden. The badge for Wyton shows a full sun with a bow in front of it, and above those a sword. The motto is *"Verum Exquiro"* ("I seek the Truth"). "Let us flourish through strength" is the translation of the motto *"Viribus Vigeamus"* on the badge which the Queen has approved for Gaydon. A ram is shown charging. The new badge for No. 173 Squadron shows a sword in its scabbard pointing diagonally down to the right and clasped beneath the hilt by an eagle's claw. On the scabbard is a gauntlet and the motto is *"Quocumque"* ("Whithersoever"). This motto is indeed apt, for the squadron is a ferry unit.

Director of Aircraft Engineering

HAVING been Command Engineer Officer at Headquarters, 2nd Tactical Air Force, since 1954, A.Cdre N. A. Tait, O.B.E., A.F.R.Ae.S., has been appointed Director of Aircraft Engineering at the Air Ministry with effect from November 1. A.Cdre. Tait joined the R.A.F. as an aircraft apprentice in 1923.

Gordon Shephard Prize

WINNERS of the 1956 Gordon Shephard Memorial Prize Essay Competition—held annually in the Royal Air Force and open to all serving members—were: 1st, G/C. W. Carter, D.F.C. (R.A.F. Ternhill); 2nd, W/C. P. le L. Le Cheminant, D.F.C. (R.A.F. Kuala Lumpur); 3rd, F/L. D. H. Hofford (R.A.F. North Weald); 4th, W/C. C. M. Clementi, O.B.E. (Joint Services Staff College). The judges were three retired Service officers, Air Marshal Sir Lawrence F. Pendred, A.Cdre. A. P. Revington, and A.Cdre. D. W. F. Bonham-Carter.

The subject was: "The change in firepower resulting from the emergence of the thermo-nuclear bomb in 1954 has had an effect on warfare which is radical, not merely one of degree. Without the benefit of past experience to guide us, the best composition of our armed forces depends on an accurate forecast of the length and form of a future war. State what you consider the most likely length and form of a major war within the next ten years, and the best composition and disposition of our forces to meet it."

Jungle Survival Demonstrations

A JUNGLE survival "demonstration section" is being established at R.A.F. Station Kuala Lumpur, the base for many different types of aircraft operating over the jungle on anti-terrorist missions. The section is being set up by F/L. L. U. Matthews, who describes the project as "a jungle classroom-*cum*-museum." It will contain specimens of edible plants and animal life, as well as the poisonous types, although F/L. Matthews points out that all animal life found in the jungle is edible —everything from water rats to snakes.

Curtis Memorial Prize

AN engine mechanic stationed at the M.E.A.F. staging post at Mauripur, near Karachi, has been awarded the Curtis Memorial Prize for obtaining the best results in the Services' General Certificate of Education examinations. He is S.A/C. J. E. Baker, a regular airman who has now passed five subjects at ordinary level and three at advanced level.

The prize was established from funds subscribed in memory of the late Colonel Ivor Curtis, educational adviser to the Air Ministry from 1918 to 1929.

Apprentice Entry

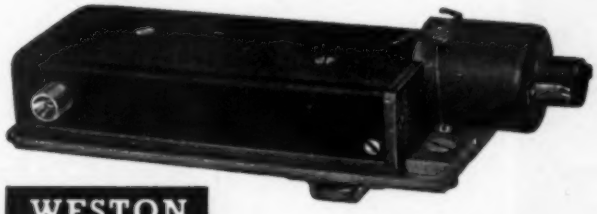
THERE are more than 40,000 airmen under 20 years of age serving in the R.A.F., and the Service is now looking for another 500 teen-age boys for the next apprentice entry in May, 1957. Nominations should be made by headmasters, youth employment officers or appropriate youth organizations by January 14 next.

R.A.F. Appointments

THE following continues a list of Royal Air Force appointments recently announced by the Air Ministry:—

W/C. E. L. Brackenbury to R.A.F. Jurby, for administrative duties; W/C. J. S. Orr to R.A.F. Cosford, for administrative duties; W/C. E. G. Farthing to H.Q. Maintenance Command, for administrative staff duties; W/C. W. Pitt-Brown, D.F.C., A.F.C., to R.A.F. Linton-on-Ouse to command (with acting rank of group captain); W/C. S. G. Taylor to H.Q., Transport Command, for technical staff duties (with acting rank of group captain); W/C. R. J. H. De Brett to H.Q., No. 8 (L.A.A.) Wing, R.A.F. Regiment, to command; W/C. C. B. Brown, A.F.C., to the R.A.F. Staff College, Bracknell, for directing staff duties; W/C. F. H. Dimmer to Ministry of Supply; W/C. G. H. D. Evans, D.S.O., D.F.C., to Air Ministry, for duty in the Department of the Chief of the Air Staff; W/C. C. C. Howes, O.B.E., to Air Ministry, for duty in the Department of the Chief of the Air Staff; W/C. W. A. Toyne, D.F.C., to H.Q., Northern Sector, for air staff duties; W/C. R. N. Wardell to Air Ministry for duty in the Department of the Chief of the Air Staff; W/C. W. J. P. Cunningham to Ministry of Supply (retaining the acting rank of wing commander); W/C. J. R. Armitstead, D.F.C., to H.Q., Coastal Command, for administrative staff duties; W/C. F. W. Avery to H.Q., Central Signals Area, for technical duties; W/C. L. J. M. Bunce to R.A.F. Wahn, for administrative duties; W/C. P. C. Fletcher, O.B.E., D.F.C., A.F.C., to the Imperial Defence College for directing staff duties; W/C. J. H. F. Ford, D.F.C., to command the Cambridge University Air Squadron; W/C. A. Hughes, D.F.C., to Air Ministry, for duty in the Department of the Chief of the Air Staff; W/C. N. W. Kearon, O.B.E., to Headquarters, Bomber Command, for administrative staff duties; W/C. P. Peters, O.B.E., D.F.C., to R.A.F. Halton, for adminstrative duties; W/C. E. C. Seeley, M.B., to Air Ministry, for duty in the Department of the Chief of the Air Staff; W/C. P. D. B. Stevens to R.A.F. Acklington, for flying duties; W/C. R. Storey to No. 54 Maintenance Unit, to command; W/C. D. W. J. Brown, to R.A.F. Stoke Heath for administrative duties; W/C. B. C. A. Fox to H.Q., A.A.F.C.E., for staff duties; W/C. E. Garrod-Cole, M.C., to Air H.Q., Malaya, for air staff duties; W/C. E. Graham to H.Q., SHAPE, for staff duties; W/C. E. T. McCabe, O.B.E., to H.Q., British Forces Aden, for technical staff duties; W/C. B. J. May to Air Ministry, for duty in the Department of the Air Member for Supply and Organization; W/C. R. D. Romians to R.A.F. Leuchars, for technical duties; W/C. E. A. L. Wakeley to Air Ministry, for duty in the Department of the Air Member for Supply and Organization; W/C. P. R. M. Williams to H.Q., F.E.A.F., for air staff duties; W/C. F. E. Croce to H.Q., Coastal Command, for technical staff duties; W/C. W. A. Jones to R.A.F. Ballykelly, for technical duties; W/C. J. G. Laurie to Air Ministry, for duty in the Department of the Chief of Air Staff; W/C. A. H. Porter, O.B.E., to R.A.F. Odiham, for technical duties; W/C. L. J. Ward, D.F.C., to Air Ministry, for duty in the Department of the Chief of the Air Staff.

S/L. P. N. Farlow to Air Ministry, for duty in the Department of the Chief of the Air Staff (with the acting rank of wing commander); S/L. K. E. Hollom to No. 91 Maintenance Unit, Acaster Malbis, to command (with the acting rank of wing commander); S/L. E. W. Cotton to R.A.F. Benson, for technical duties (with acting rank of wing commander); S/L. R. F. Jones to R.A.F. Oakington, for technical duties (with acting rank of wing commander); S/L. V. S. Swain, D.F.C., to the R.A.F. Staff College, Bracknell, for directing staff duties (with acting rank of wing commander); S/L. B. D. Green to R.A.F. Defford, for flying duties (with acting rank of wing commander); S/L. D. C. Lowe, D.F.C., A.F.C., to Air Ministry for duty in the department of the Chief of the Air Staff (with acting rank of wing commander); S/L. P. E. Vaughan-Fowler, D.S.O., D.F.C., A.F.C., to H.Q., 2nd T.A.F., for air staff duties (with acting rank of wing commander); S/L. A. Stewart to R.A.F. Pembrey, for technical duties (with acting rank of wing commander); S/L. R. E. Powell to No. 12 School of Technical Training for technical duties (with acting rank of wing commander); S/L. D. H. Beckett, O.B.E., to the Central Fighter Establishment, for technical duties (with the acting rank of wing commander); S/L. G. E. S. Bumstead to No. 2 Wing, Aden Protectorate Levies, to command (with the acting rank of wing commander); S/L. A. Powell to R.A.F. Henlow, for administrative duties (with the acting rank of wing commander); S/L. D. M. B. Fitzgerald-Lombard to Troop Transport Duties, as O.C. Troops (with acting rank of wing commander); S/L. R. G. C. Castell to R.A.F. Chivenor, for technical duties (with the acting rank of wing commander); S/L. W. L. Clarke to the Central Flying School, R.A.F. Little Rissington, for technical duties (with the acting rank of wing commander); S/L. G. C. R. Ackrill, M.B.E., to R.A.F. Locking for administrative duties (with the acting rank of wing commander).



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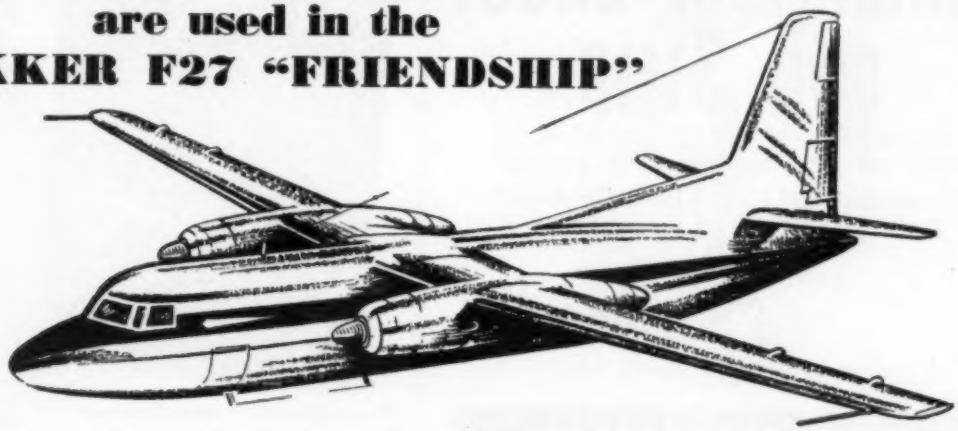

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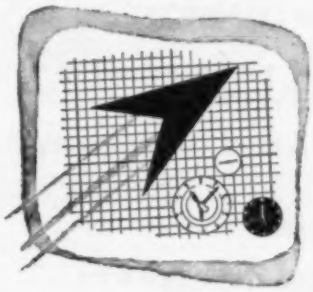

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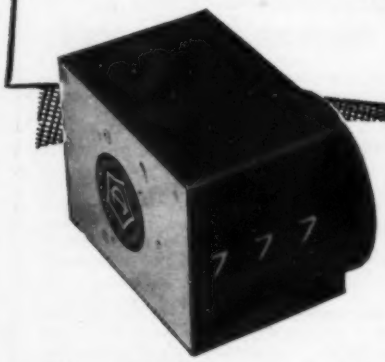

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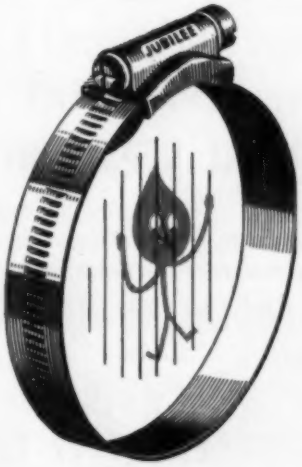

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quoting reference ADO/T/7.

FLIGHT and AIRCRAFT ENGINEER

PRESS DAY—*Classified advertisement "copy" should reach Head Office by* FIRST POST THURSDAY *for publication in the following week's issue subject to space being available.*

CLASSIFIED ADVERTISEMENTS

Advertisement Rates. 5/- per line, minimum 10/-, average line contains 6-7 words. Special rates for Auctions, Contracts, Patents, Legal and Official Notices, Public Announcements, Public Appointments, Tenders 6/- per line, minimum 12/-. Each paragraph is charged separately, name and address must be counted. All advertisements must be strictly prepaid and should be addressed to FLIGHT Classified Advertisement Dept., Dorset House, Stamford Street, London, S.E.1.

Postal Orders and cheques sent in payment for advertisements should be made payable to Iliffe & Sons, Ltd., and crossed & Co.

Trade Advertisers who use these columns regularly are allowed a discount of 5% for 13, 10% for 26 and 15% for 52 consecutive insertion orders. Full particulars will be sent on application.

Box Numbers. For the convenience of private advertisers, Box Number facilities are available at an additional charge for 2 words plus 1/- extra to defray the cost of registration and postage, which must be added to the advertisement charge. Replies should be addressed to "Box 0000, c/o Flight," Dorset House, Stamford Street London, S.E.1.

The Publishers retain the right to refuse or withdraw advertisements at their discretion and do not accept liability for delay in publication or for clerical or printer's errors although every care is taken to avoid mistakes.

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IN THE MATTER
of
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LIMITED
and
IN THE MATTER OF THE COMPANIES ACT, 1948

NOTICE is hereby given that the creditors of the above-named Company, which is being voluntarily wound up, are required, on or before the 14th day of December, 1956, to send in their full Christian and surnames their addresses and descriptions, full particulars of their debts or claims and the names and addresses of their Solicitors (if any), to the undersigned Kenneth William Chapman of 79 Northcroft Road, West Ealing, London, W.13, the Liquidator of the said Company, and, if so required by notice in writing from the said Liquidator, are, personally or by their Solicitors, to come in and prove their debts or claims at such time and place as shall be specified in such notice, or in default thereof they will be excluded from the benefit of any distribution made before such debts are proved.

DATED this 10th day of November 1956.

K. W. CHAPMAN, Liquidator.

N.B. This Notice is purely formal. All known creditors have been or will be, paid in full. [5957

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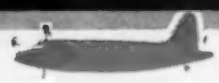

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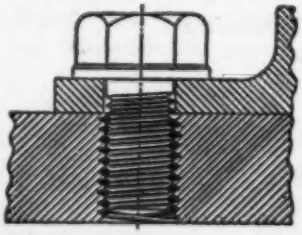

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SALARY: £2,077/£2,242 per annum.

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APPLICATION forms obtainable from the

Senior Representative (AP.72),

Department of Supply,

Australia House,

Strand,

London, W.C.2.

WITH whom applications should be lodged by 15th December, 1956. [5954

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(AIRCRAFT)
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Please apply, giving full details, to the **Personnel Officer, Ferranti Limited, Ferry Road, Edinburgh 5, quoting Ref. CI/TID/29.**

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 985. From Transair Ltd., of Croydon Airport, Croydon, Surrey, supported by Airwork Ltd., for permission for Transair Ltd. to take over from Airwork Ltd. the All Freight Service which has been authorised for operation by the latter company during the period up to 31st May, 1963, on the route London Airport-Dusseldorf (Application No. 417) at a frequency of three return flights per week. Transair Ltd. ask permission to operate the All Freight Service not dependent on services on other routes.

FROM Airviews, Ltd., of Manchester Airport, Ringway, Manchester:—

APPLICATION No. 986 for a Seasonal U.K. Internal Service with D.H.89 aircraft and later possibly with D.H. Dove aircraft for the carriage of passengers, supplementary freight and mail between Manchester (Ringway) and Bristol (optional) and Exeter at a frequency of up to four services weekly during the season from April to October inclusive each year for a period of 10 years, commencing April 1957.

APPLICATION No. 987 for a U.K. Internal Service with D.H.89 aircraft and later possibly with D.H. Dove aircraft for the carriage of passengers, supplementary freight and mail between Manchester (Ringway) and West Hartlepool (Greatham) at a frequency of from one to three services weekly for a period of 10 years, commencing 1957.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not submitted to the Council, should reach them within the period allowed for the making of representations or objections. [5949

TUITION

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A

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All subjects for professional pilot or navigator licences and ratings embracing Academic, Technical, Simulated and Flying aspects. Full-time personal coaching, also short periods. Home study excellent alternative.
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The only fully equipped private School of Aviation. Specialist staff, comprehensive equipment and full residential and recreational facilities within the School ensures the soundest training for an aviation career.

M.T.C.A. APPROVED COURSES

for private and commercial pilots' licences and maintenance engineers' licences in categories "A" and "C."

HELICOPTER COURSES

for private and professional licences. Details available from the Commandant.

AIR SERVICE TRAINING, LTD.

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CIVIL PILOT/NAVIGATOR LICENCES

AVIGATION, LTD., provides full-time or intermittent instruction and postal tuition, or a combination of any of these methods to suit individual requirements for the above licences. Classroom instruction can be provided for A.R.B. General, certain Specific Types and Performance Schedule examinations. Link training Dept. at MONarch 1364.

FOR full details apply to The Principal,

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A SUCCESSFUL career for your son. Aeronautical Technical and practical training for all branches of aeronautical engineering. Diploma course leads to executive appointments in civil aviation design and development, draughtsmanship, maintenance, etc. Extended courses to prepare for A.F.R.Ae.S. and A.M.I.Mech.E. examinations. Write for prospectus to Engineer in Charge, College of Aeronautical Engineering, Chelsea, London, S.W.3. FLAxman 0021. [0019

MANAGEMENT TRAINEES

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Large expanding light engineering Company in South Midlands is prepared to engage a selected number of Young Men (23-30) for training through technical work, foremanship and on eventually to Managerial Posts. Qualifications required:

1. Secondary Grammar School Education.
2. H.N.C. standard in Mechanical Engineering.
3. Five-year apprenticeship in reputable engineering firm or equivalent experience.

Applicants must be prepared for factory hours during training (including nightshift if necessary) and to work hard for a number of years to fit themselves for the higher posts in engineering industry. Apply in own writing giving age, qualifications, present salary and career to date in chronological order.
Box No. 5090 c/o Flight.

GLOSTER AIRCRAFT CO. LTD.

GLOUCESTER,

have vacancies for

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ELECTRICAL AND STRUCTURAL

Aircraft experience desirable but not essential.

The factory is ideally situated in the Cotswolds. Pension scheme, good canteen, welfare and sports facilities. Single accommodation available in Residential Club.

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to work on Aircraft-type Structures and Mechanisms.

Vacancies exist in

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Previous experience on this type of work is desirable but not essential.

Good salaries will be paid and excellent prospects exist for men with ability and energy. Pension and Life Assurance Scheme.

Applications should be addressed to the

PERSONNEL MANAGER,
HUNTING PERCIVAL AIRCRAFT LIMITED,
LUTON AIRPORT, BEDS

quoting Ref. W.R.D./A./6, and giving full details of qualifications, experience, age and salary required.

SAUNDERS-ROE LTD.

require

SENIOR

AERODYNAMICISTS
STRESS ENGINEERS
DRAUGHTSMEN

and other Technicians at their London and Osborne, I.o.W., design offices.

Qualified design engineers—resourceful men of original thinking and mature engineering judgement—who can meet the challenge of new problems, owe it to themselves to investigate the career opportunities now available in our organisation.

We can offer pleasant working conditions, salaries commensurate with ability, and assistance with accommodation for candidates selected to work at Osborne.

★ **Those interested should apply, quoting age, experience, qualifications and ref. F/10 to the Personnel Officer, Saunders-Roe Ltd., East Cowes, I.o.W.**

AIRCRAFT ELECTRICAL ENGINEER

FERRANTI LIMITED, EDINBURGH

require an

AIRCRAFT ELECTRICAL ENGINEER

as a Section Leader in their Flying Unit Electrical Workshop. Applicants should hold A.R.B. "X" Electrical Licence and have experience on Piston and Turbine Aircraft Servicing, repair and installation work for flight test equipment. Pensionable staff position offering good propects. Interview will be arranged in either EDINBURGH or LONDON and at times to suit convenience of applicants. Please apply, giving full details of training and experience, to the

Personnel Officer, Ferranti Limited, Ferry Road, Edinburgh, 5, quoting Ref. AEE/TID/29.

VICKERS-ARMSTRONGS (AIRCRAFT) LTD.,

Bournemouth (Hurn) Airport
NR. CHRISTCHURCH, HANTS

require:

THREE SENIOR DESIGN DRAUGHTSMEN FOR CIVIL AIRCRAFT INTERIORS

Previous experience of this work, together with good structural background essential to fulfil requirements of Viscount and New Project design programme.

Applications, quoting date of advertisement and prefix letter 'q,' to:

Employment Manager,
Vickers-Armstrongs (Aircraft) Ltd.,
Bournemouth (Hurn) Airport,
Nr. Christchurch, Hants.

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Regular work and Overtime

APPLY TO:

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TUITION

FREE. Brochure giving details of courses in all branches aero eng., covering A.F.R.Ae.S., M.C.A. exams, etc. Also courses for all other branches of engineering.—Write: E.M.I. Institutes, Dept. F.26, London, W.4. (Associated with H.M.V.) [0964

SITUATIONS VACANT

SAUNDERS-ROE LIMITED

require

six technicians interested in aircraft and missile stability and control to join an

ANALOGUE COMPUTER TEAM

APPLICANTS should have experience in one of the following:
AERODYNAMIC Stability,
SERVO-mechanisms,
FLUTTER or Electronics.

THEY must possess an engineering degree or H.N.C., as theoretical evaluation and test work is involved.

ASSISTANCE with accommodation is available, conditions are good and salaries will be commensurate with ability.

THOSE interested should apply quoting age, experience, qualifications and ref. F.13 to the Personnel Officer, Saunders-Roe Ltd., East Cowes, Isle of Wight. [5911

MANAGEMENT SELECTION LIMITED

have been invited to advise on the selection of a

CHIEF ENGINEER

FOR a factory in the South (which is part of a large group) and employing approximately 200, mainly on aero engine reconditioning. The position would satisfy someone wishing to be a senior technical manager in a medium sized firm. The duties include formulation of standards, inspection, quality control and technical liaison with customers by visits at home and occasionally overseas.

CANDIDATES should have served an apprenticeship or equivalent, must be thoroughly conversant with aero engine practice and preferably a good knowledge of radial engines. H.N.C. or similar qualification plus experience of jet engines useful. Starting salary £1,750-£1,900 p.a.

PLEASE send brief details to H. E. Roff (V.189), Management Selection Limited, 8 Clarges Street, W.1. No information will be passed to our clients without candidate's permission at interview. [5940

GRADUATES IN MECHANICAL ENGINEERING

A LARGE industrial organisation of international standing offers qualified engineers interesting and satisfying careers in the metals industry.

THE Company's varied activities are concerned with a variety of industries, including building, electricity, motor vehicles, aircraft, atomic and nuclear energy. Promising graduates are required to work on important research, design and development projects connected with nearly all these activities.

COMMENCING salaries will largely be determined by age and experience but will rise rapidly by annual increments to at least £1,300 per annum. Prospects of considerably higher salaries will be available to those showing exceptional ability.

THESE are permanent positions and offer membership of the superannuation fund, a five-day week and excellent working, social and sports facilities.

APPLICATIONS, giving brief details of qualifications, and experience, should be sent in strict confidence to Box No. 5283. [5944

THE COLLEGE OF AERONAUTICS

APPLICATIONS are invited for the appointment of Demonstrator in the Department of Aircraft Electrical Engineering to take charge of the everyday running and maintenance of a teaching and research laboratory devoted to work in the telecommunications, radio navigational, radar and microwave fields. Preference will be given to candidates holding a university degree or professional qualification. Experience in aeronautical applications of any of the above fields is an added qualification but candidates without such experience will be considered. Salary dependent on qualifications and experience within a range rising to £1,050 per annum with family allowance. Successful candidate would be considered for promotion to a lectureship appointment at a later date. Applications (quoting reference ER/D) giving full particulars and the names of three referees should be forwarded to the Recorder, The College of Aeronautics, Cranfield, Bletchley, Bucks., from whom further particulars may be obtained. [5945

PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 985. From Transair Ltd., of Croydon Airport, Croydon, Surrey, supported by Airwork Ltd., for permission for Transair Ltd. to take over from Airwork Ltd. the All Freight Service which has been authorised for operation by the latter company during the period up to 31st May, 1963, on the route London Airport-Dusseldorf (Application No. 417) at a frequency of three return flights per week. Transair Ltd. ask permission to operate the All Freight Service not dependent on services on other routes.

FROM Airviews, Ltd., of Manchester Airport, Ringway, Manchester:—

APPLICATION No. 986 for a Seasonal U.K. Internal Service with D.H.89 aircraft and later possibly with D.H. Dove aircraft for the carriage of passengers, supplementary freight and mail between Manchester (Ringway) and Bristol (optional) and Exeter at a frequency of up to four services weekly during the season from April to October inclusive each year for a period of 10 years, commencing April 1957.

APPLICATION No. 987 for a U.K. Internal Service with D.H.89 aircraft and later possibly with D.H. Dove aircraft for the carriage of passengers, supplementary freight and mail between Manchester (Ringway) and West Hartlepool (Greatham) at a frequency of from one to three services weekly for a period of 10 years, commencing 1957.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not submitted to the Council, should reach them within the period allowed for the making of representations or objections. [5949

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SURREY Flying Club, Croydon Airport, M.C.A. approved for private pilots' licences. Open seven days a week. Croydon 7744. [0293

LEARN to fly, £26; Instructor's Licences and Instrument flying for £3 5s. per hour. Night flying £4 5s. per hour. Residence 6 guineas weekly. Approved M.C.A. Private Pilots' Licence course. Specialized course for Junior Commercial Pilot's Licence.—Wiltshire School of Flying, Ltd., Thruxton Aerodrome (Andover Junction 1 hour 15 minutes from Waterloo), Hants. [0253

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A

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is required for the Division Research Department to undertake interesting work on basic metal forming processes and on new techniques of metal forming. Candidates should possess a University degree in mechanical engineering. Post-graduate research work or experience in the metal working field would be advantageous.

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Kynoch Works,
Witton, Birmingham 6,
quoting RES/26/F.

★ *Ministry Approved Courses* ★
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Commercial Pilot and Instrument Rating
at the
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All subjects for professional pilot or navigator licences and ratings embracing Academic, Technical, Simulated and Flying aspects. Full-time personal coaching, also short periods. Home study excellent alternative.
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for private and commercial pilots' licences and maintenance engineers' licences in categories "A" and "C."

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for private and professional licences. Details available from the Commandant.

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A.F.R.Ae.S., A.R.B. Certs., A.M.I.Mech.E., etc., on "no pass, no fee" terms. Over 95 per cent. successes. For details of exams and courses in all branches of aeronautical work, navigation, mechanical eng., etc., write for 144-page handbook free.—B.I.E.T. (Dept. 702), 10 Wright's Lane, London, W.8. [0707

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Box No. 5090 c/o Flight.

GLOSTER AIRCRAFT CO. LTD.

GLOUCESTER,

have vacancies for

DRAUGHTSMEN

ELECTRICAL AND STRUCTURAL

Aircraft experience desirable but not essential.

The factory is ideally situated in the Cotswolds. Pension scheme, good canteen, welfare and sports facilities. Single accommodation available in Residential Club.

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LUTON AIRPORT, BEDS

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SAUNDERS-ROE LTD.

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SENIOR
AERODYNAMICISTS
STRESS ENGINEERS
DRAUGHTSMEN

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VICKERS-ARMSTRONGS (AIRCRAFT) LTD.,

Bournemouth (Hurn) Airport

NR. CHRISTCHURCH, HANTS

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BROOKLANDS AVIATION LTD.

NORTHAMPTON

require

SENIOR INSPECTORS

for work on

VALETTA and VARSITY AIRCRAFT

Regular work and Overtime

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Buttocks Booth, Houlton, Northampton

TUITION

FREE. Brochure giving details of courses in all branches aero eng., covering A.F.R.Ae.S., M.C.A. exams, etc. Also courses for all other branches of engineering.—Write: E.M.I. Institutes, Dept. F.26, London, W.4. (Associated with H.M.V.) [0964

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PLEASE send brief details to H. E. Roff (V.189), Management Selection Limited, 8 Clarges Street, W.1. No information will be passed to our clients without candidate's permission at interview. [5940

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TECHNICAL AUTHORS AND ILLUSTRATORS

for the

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BRISTOL Aircraft Limited need technical authors and technical illustrators to work in their guided weapons department. They will compile instructional handbooks, manuals and catalogues in the field of guided weapons.

Authors should have a good technical background, and illustrators should be men capable of producing sectional perspectives from drawings. Engineers who have either writing or drawing experience might be interested in the job, as it covers both mechanical and electronic aspects of guided weapon work.

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Mr P A TOBIN, Room FDO/76/JF
BRISTOL AIRCRAFT LIMITED
Filton House, Bristol

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED

at WEYBRIDGE WORKS, WEYBRIDGE, SURREY, and HURN DEPOT, NR. BOURNEMOUTH, HANTS,

require well qualified

AERODYNAMICISTS AND STRESSMEN

for work on advanced projects.

Applications, quoting date of advertisement and prefix letter 'r' to:

Employment Manager, Vickers-Armstrongs (Aircraft) Limited, Weybridge Works, Weybridge, Surrey.

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BRISTOL AIRCRAFT LIMITED need a navigator for their flight testing department, to instruct their customers' crews on all aspects of Britannia flight planning. Duties will include occasional overseas flights.

If you are interested, write, giving details of age, qualifications and experience, to:

MR P A TOBIN, ROOM AIR/71/JF
BRISTOL AIRCRAFT LIMITED
FILTON HOUSE, BRISTOL

BRISTOL

BRISTOL AIRCRAFT LIMITED

SITUATIONS VACANT

BUSH PILOTS

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Contracts in Turkey and Persia.

THEY should have a valid commercial pilot's licence or higher and be capable of carrying out maintenance on a Cessna 180 aircraft. Preference given to pilots with both single and twin engine experience. A VERY generous salary will be given commensurate with experience. Apply in first instance, in writing, to:—

The Personnel Manager,

Costain-John Brown, Ltd.,

73 South Audley Street,

London, W.1.

QUOTING reference D.0623 [5951

ARMSTRONG SIDDELEY MOTORS, LIMITED

has requirements in

the Flight and Performance Department for

(1) A Mechanical Engineer to work on performance calculations (predictions and flight analyses) and associated problems with new engines. A degree standard is usually necessary but engineers with comparable experience will be considered.

(2) An Engineer with a H.N.C. in Mechanical Engineering with some electrical knowledge for practical work on the design and manufacture of instruments for use in flight development testing of new engines.

SALARIES will be commensurate with experience and ability. If desired, private circumstances will be fully considered.

APPLICATIONS, quoting FP, to the Technical Personnel Manager, Armstrong Siddeley Motors, Limited, Coventry. [5850

BAHAMAS HELICOPTERS, LTD., require an unmarried licensed Radio/Electrical Engineer for their S-55 and Bell helicopters in British North Borneo. Licence category X electrical equipment under 30 volts D.C. is required. Three-year contract, with good salary, leave and allowances. Please write full details to Box 5282. [5947

SITUATIONS VACANT

MANAGEMENT SELECTION LIMITED

have been retained to advise on the selection of a

PRODUCTION MANAGER

FOR a medium sized company (part of a larger group) located in the Midlands engaged on the manufacture of major aircraft components. The company is expanding and requires a person with considerable experience of modern production control procedures, covering process planning, progress and stores.

CANDIDATES should have an engineering background and a knowledge of the aircraft industry would be helpful. Age 30/45. Starting salary £1,200-£1,500 p.a. according to experience.

PLEASE send brief details to H. E. Roff (V.192), Management Selection Limited, 17 Stratton St., W.1. No information will be passed to our clients without candidate's permission at interview. [5939

MATHEMATICIAN

A TECHNICIAN with an honours degree in mathematics is required to work at Osborne, Isle of Wight. Two or three years experience of the industrial application of mathematics to problems of elasticity and thermo-elasticity would be advantageous but is not essential.

ASSISTANCE with accommodation is available, conditions are good and the salary will be commensurate with ability.

APPLICATIONS, quoting age, experience, qualifications and ref. F/15 should be addressed to the Personnel Officer, Saunders-Roe, Ltd., East Cowes, I.O.W. [5955

MORTON AIR SERVICES require fully qualified radio officers home and overseas. Starting rate £885, plus generous overseas allowances. Apply Croydon 7171. [0477

DON EVERALL AVIATION, LTD., require Dakota Captains and First Officers, B.A.L.P.A. rates. Apply giving details of experience, licences held, etc., to Don Everall Aviation, Ltd., Elmdon Airport, Birmingham. [5952

ELECTRICAL Engineer, preferably "X" licence required immediately for the maintenance of Dove, Heron and Dakota equipment. Permanent position with prospects offered. Apply to Chief Engineer, Cambrian Airways, Ltd., Cardiff (Rhoose) Airport, nr. Barry, Glam. Tel. Rhoose 334. [5921

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AIRCRAFT COMPANY LTD.

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Due to responsibilities for certain projects having been transferred to this factory, a considerable expansion of the DESIGN ORGANISATION is necessary to deal with an extensive programme of work on new projects and development of established types of Civil Aircraft.

Excellent and progressive opportunities exist for:

★ **SENIOR DESIGNERS**

DESIGN DRAUGHTSMEN

INTERMEDIATE DRAUGHTSMEN

★ **SENIOR STRESSMEN**

JUNIOR STRESSMEN

★ Aircraft experience essential, but those with mechanical, civil or shipbuilding experience are invited to apply for the other posts.

Pension and life assurance schemes for senior staff. • Superannuation scheme for weekly staff • Assistance given in obtaining housing.

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HESTON AIRPORT, Hounslow, Middlesex

have immediate openings in their

DESIGN OFFICE

on a new and interesting **Civil Aeroplane** for:

SENIOR, INTERMEDIATE and JUNIOR DRAUGHTSMEN

EXPERIENCED STRESSMEN

LOFTSMEN

Long-Term Programme

Good opportunities

Please write with full particulars to:

THE CHIEF DESIGNER

FLIGHT TRIALS DEPARTMENT

of

SMITHS AIRCRAFT INSTRUMENTS LTD.

have vacancies for staff to be responsible for installation and flight test observer work on Auto controls and Flight Systems.

IMMEDIATE SENIOR POSITIONS

can be taken up by qualified Engineers, interested in flying, with experience in light Electro-Mechanical Engineering field, such as Gyroscopes, Electronics, Radar, Navigational Aids, Servo-Systems, etc. Consideration will also be given to Graduates, without previous experience, who have completed National Service.

Candidates must be prepared to travel in the United Kingdom and abroad.

Apply to

Divisional Personnel Manager, Smiths Aircraft Instruments Limited, Bishops Cleeve, Nr. Cheltenham, quoting reference 85/EN/13.

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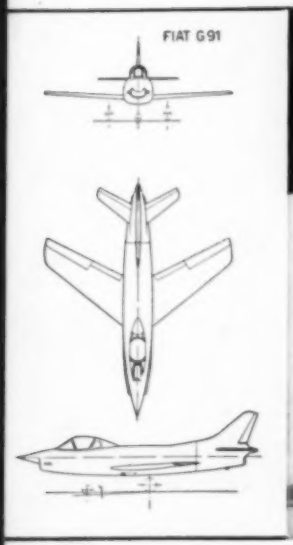

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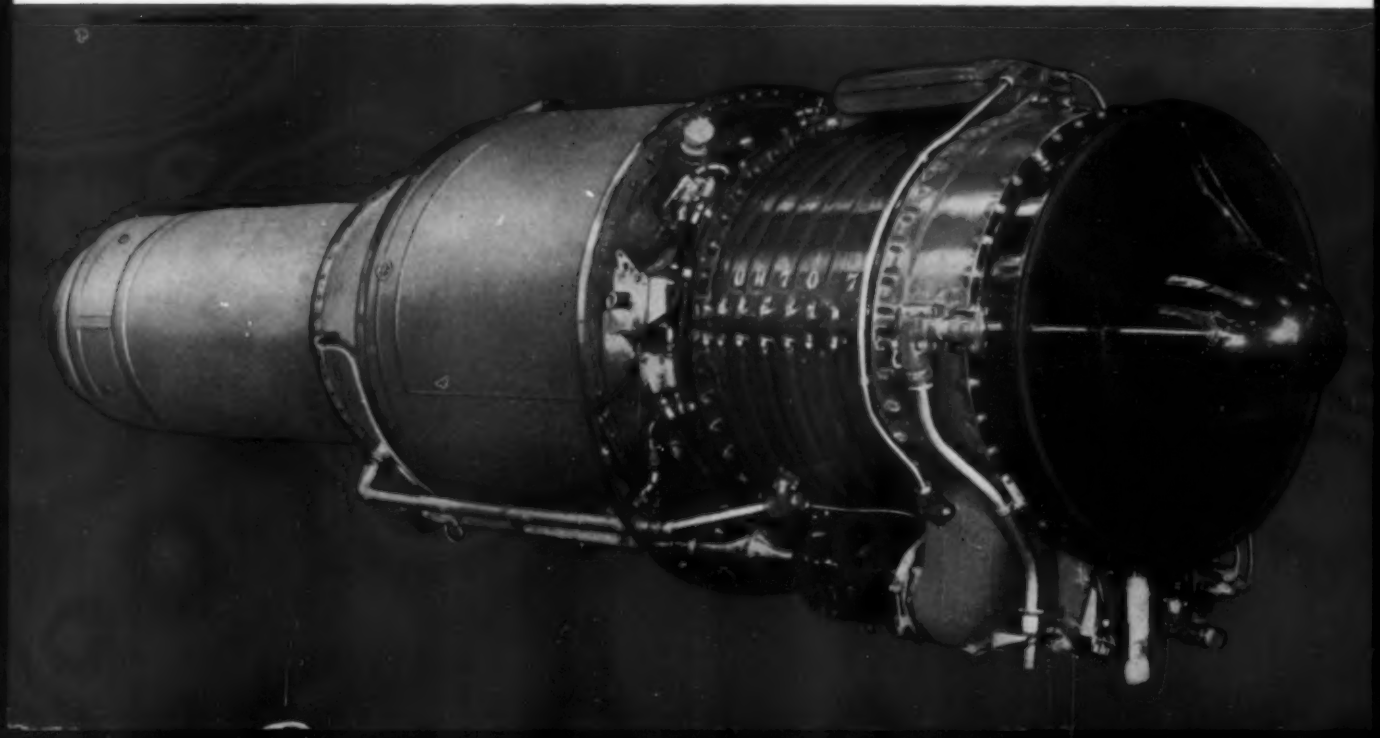
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